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EXECUTIVE SUMMARY GEOTECHNICAL SITING INVESTIGATIONS FY 81.(U)
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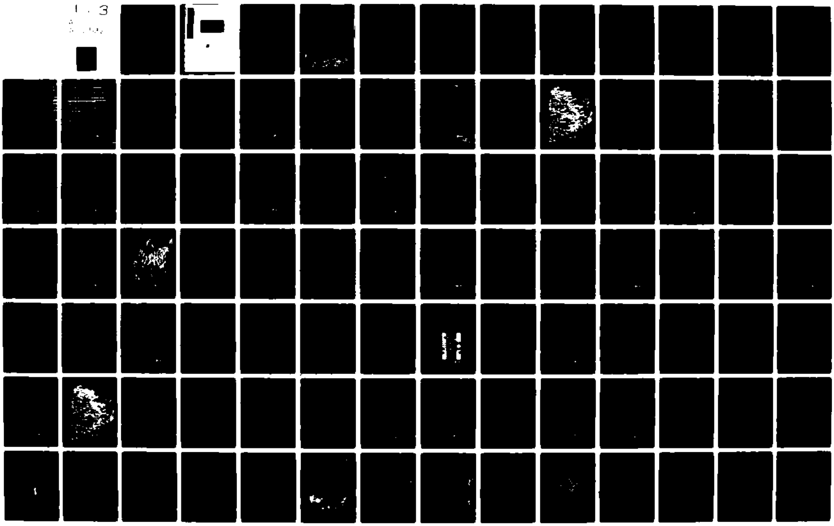

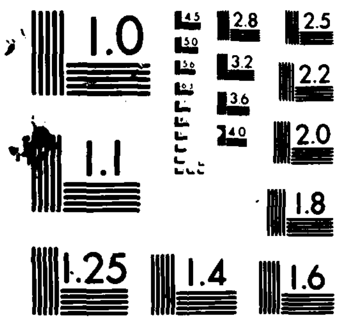

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EXECUTIVE SUMMARY
GEOTECHNICAL SITING INVESTIGATIONS
FY 81

Prepared for:

U.S. Department of the Air Force
Ballistic Missile Office
Norton Air Force Base, California 92409

Prepared by:

Ertec Western, Inc.
3777 Long Beach Boulevard
Long Beach, California 90807

30 November 1981

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Report is summary of geotechnical studies for the M-X program in Nevada and Utah conducted by Ertec [illegible] for the Air Force. The programs are divided into four major programs, eight support programs, and three miscellaneous studies.

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FOREWORD

This report was prepared for the Department of the Air Force, Ballistic Missile Office (BMO), Norton Air Force Base, California, in compliance with Contract No. F04704-80-C-0006, CDRL Item 005A6. Summary discussions included in this report describe programs that were conducted in Fiscal Year 1981 (FY 81). Many of the FY 81 programs are continuations of studies begun in previous years. More details on these prior programs are included in reports listed in Appendix A and in three previous geotechnical summary reports:

- Geotechnical Siting Status Report - 21 June 1978;
- Executive Summary Report, Geotechnical Siting Investigations FY 79, FN-TR-30, dated 26 October 1979; and
- Executive Summary Report, Geotechnical Siting Investigations, FY 80, FN-TR-42, dated 30 November 1980.

The major FY 81 programs, in terms of scope and effort, are Verification (Section 2.0), Water Resources (Section 3.0), Aggregate Resources (Section 4.0), and Siting Studies (Section 5.0). These programs are largely continuations of studies that were initiated in FY 79 and FY 80 to provide technical data to support MX siting decisions and to provide data needed by other MX associate contractors. Report Section 6.0 contains discussions of the other geotechnical studies performed in FY 81.

It should be noted that the geotechnical siting investigations were performed under the firm name of Fugro National, Inc. at its offices in Long Beach, California, in previous years. On 25 March 1981 the corporate name was changed to the Earth Technology Corporation (Ertec). Since that date, the geotechnical studies have been performed at the same Long Beach office under the name of Ertec Western, Inc. Environmental support has been provided by Ertec Northwest, Inc., Seattle, Washington, topographic mapping services have been provided by Ertec Airborne Systems, Inc., Cypress, California, and mineral resources surveys have been performed by Ertec Rocky Mountain Inc., Denver, Colorado.

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LIST OF DRAWINGS

1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this report is to summarize the results of the geotechnical, siting, and environmental programs performed by Ertec, Inc. in FY 81 in support of the U.S. Air Force MX advanced ICBM program. Because the report is an overview, discussions are limited to presenting the scope, objectives, and summary findings of each program. The details of these studies are included in reports which were submitted during the year.

1.2 STUDIES PRIOR TO FY 81

The FY 81 Executive Summary has limited discussions about the studies performed in prior years even though many of the programs are continuations of programs started one or two years earlier. The FY 79 and FY 80 programs are summarized in Executive Summary Reports similar to this document (FN-TR-30 and FN-TR-42). The studies performed in FY 77 and FY 78 are summarized in a Geotechnical Siting Status Report which was submitted on 21 June 1978. The details of the geotechnical, environmental, and siting studies performed since 1974 are presented in separate reports, all of which are listed in chronological order in Appendix A. Including FY 81, the total number of reports submitted to the Air Force on the MX project over a period of nearly 6 1/2 years is 124, 107 of which are designated by a technical report number.

1.3 FY 81 PROGRAM

The schedules and milestone of the FY 81 programs are listed in Table 1-1. The multidisciplined programs can be divided into four major programs, seven support programs, and three miscellaneous studies. The major programs are:

- o Verification,
- o Water Resources,
- o Aggregate Resources, and
- o Siting

The support programs are:

- o Fault Studies,
- o Gravity Studies,
- o Environmental Field Surveys,
- o Mineral Resources,
- o Aerial Photos,
- o Topographic Mapping, and
- o OB Studies.

The miscellaneous studies include road design methodology, response to DEIS comments, and site selection for resistivity tests. The deliverables for these 14 programs included 44 reports, six different deliverables of maps and documents produced within the siting program including shelter layouts in 37 valleys and a land acquisition package and topographic maps for three OB sites and two valleys. Most of the programs were performed by the technical staff at Ertec Western, Long Beach, California; the staff included geologists, engineering geologist, geohydrologists, soils engineers, geophysicists, and geographers. The aerial photos and topographic mapping tasks were performed by Ertec Airborne Systems, Cypress, California. The environmental studies were conducted by environmental scientists at Ertec Northwest, Seattle, Washington, and the

REPORTS (▲)	GEOTECHNICAL PROGRAM

REPORTS (▲)

1. VERIFICATION STUDIES, DELAMAR VALLEY (FN-TR-27-DM-I & II) PINE VALLEY (FN-TR-27-PI-I & II), AND WAH WAH VALLEY (FN-TR-27-WA-I & II)
2. VERIFICATION STUDIES, PAHROC VALLEY (E-TR-27-PA-I & II) AND MULESHOE VALLEY (E-TR-27-MS-I & II).
3. VERIFICATION STUDIES, LAKE VALLEY (E-TR-27-LV-I & II).
4. VERIFICATION STUDIES, CAVE VALLEY (E-TR-27-CV-I & II)
5. FAULT STUDIES REPORT (E-TR-54)
6. GRAVITY REPORT, BIG SMOKY VALLEY (FN-TR-33-BS)
7. GRAVITY REPORT, PINE VALLEY (E-TR-33-PI REV.)
   GRAVITY REPORT, WAH WAH VALLEY (E-TR-33-WA)
8. GRAVITY REPORT, LAKE VALLEY (E-TR-33-LV)
   GRAVITY REPORT, SPRING VALLEY (E-TR-33-SP)
9. GRAVITY REPORT, PAHROC VALLEY (E-TR-33-PA)
10. GRAVITY REPORT, DELAMAR VALLEY (E-TR-33-DM)
11. GRAVITY REPORT, RALSTON VALLEY (E-TR-33-RV)
12. GRAVITY REPORT, DUGWAY VALLEY (E-TR-33-DW REV.)
    GRAVITY REPORT, SEVIER DESERT (E-TR-33-SD REV.)
13. GRAVITY REPORT, CAVE VALLEY (E-TR-33-CV)
    GRAVITY REPORT, MULESHOE VALLEY (E-TR-33-MS)
14. INDUSTRY ACTIVITY INVENTORY, NEVADA-UTAH 2 SEPT 80
15. WATER RESOURCES PROGRAM, INTERM REPORT 31 OCT 80 (FN-TR-40)
16. WATER RIGHTS INVENTORY, NEVADA-UTAH 19 DEC 80
17. WATER RESOURCES PROGRAM PROGRESS REPORT 13 FEB 81
18. WATER RESOURCES PROGRAM OPERATIONAL BASE STUDIES REPORT
    VOLUME I -COYOTE SPRING OB, NEVADA (E-TR-51-I), 28 MAY 81
    VOLUME II- MILFORD AND BERYL OB UTAH (E-TR-51-II), 28 MAY 81
19. PRELIMINARY WATER MANAGEMENT PLAN 14 VALLEYS 28 SEPT 81 (E-TR-53)
20. TECHNICAL SUMMARY REPORT (E-TR-52)
    WATER RESOURCES MODELING, DRY LAKE (E-TR-56)
    CARBONATE STUDY, COYOTE SPRING VALLEY (E-TR-57)
21. VSARS LAKE VALLEY (FN-TR-37f)
    VSARS PINE AND WAH WAH VALLEYS (FN-TR-37g)
22. DARS DELAMAR VALLEY (E-TR-47-DM)
    DARS DRY LAKE VALLEY (E-TR-47-DL)
23. DARS MULESHOE VALLEY (E-TR-47-MS)
    DARS PAHROC VALLEY (E-TR-47-PA)
24. DARS PINE VALLEY (E-TR-PI)
    DARS WAH WAH VALLEY (E-TR-47-WW)
25. VSARS GARDEN-COAL VALLEYS (E-TR-37f)
    VSARS TULE VALLEY (E-TR-37h)
26. VSARS CAVE-STEPTOE VALLEYS (E-TR-37e)
27. REGIONAL LAYOUT-NEVADA/UTAH (1:500,000 MAP) 26 SEPT 1980
28. DTN PROPOSED ROUTING-FIRST 360 MILES (MAPS PRODUCED BY PARSONS)
29. PRELIMINARY BIOLOGICAL AND CULTURAL RESOURCES INVENTORY OF PROPOSED OB SITES AT COYOTE SPRING, BERYL, AND MILFORD (FN-TR-46)
30. PRELIMINARY LAYOUTS FOR ALL 37 VALLEYS (1:62,500 MAPS) 15 MAY 1981
    MX SYSTEM-NEVADA/UTAH (1:500,000 MAP) 15 MAY 1981
31. SHELTER LAYOUTS-IOC VALLEYS (1:9600 MAPS)
32. FIELD SURVEYS, IOC VALLEYS (E-TR-48-I, II-I, II-II, III-I-III-II)
33. LAND WITHDRAWAL PACKAGE
34. MX SYSTEM SITING SUMMARY REPORT (E-TR-58)
    FIELD SURVEYS, DTN/OBTS (E-TR-59-I, II, III)
35. COYOTE SPRING OB SITE, (1:9600 TOPOGRAPHIC MAPS)
36. BERYL OB SITE (1:9600 TOPOGRAPHIC MAPS)
37. MILFORD OB SITE (1:9600 TOPOGRAPHIC MAPS)
38. HAMLIN VALLEY (1:9600 TOPOGRAPHIC MAPS)
39. LAKE VALLEY (1:9600 TOPOGRAPHIC MAPS)
40. COYOTE SPRING OB REPORT (FN-TR-43)
41. MILFORD OB REPORT (FN-TR-44)
42. BERYL OB REPORT (FN-TR-45)
43. EASTERN COYOTE SPRING VALLEY
    PHOTO GEOLOGIC INTERPRETATION (E-TR-PG-II)
44. MX MINERAL RESOURCES SURVEY (FN-TR-41)
45. MX MINERAL RESOURCES SURVEY, SEVEN ADDITIONAL VALLEYS (E-TR-50)
46. FY 80 EXECUTIVE SUMMARY (FN-TR-42)
47. FY 81 EXECUTIVE SUMMARY (E-TR-56)

GEOTECHNICAL PROGRAM

VERIFICATION
- FIELD STUDIES
- DATA AND LAB ANALYSES
- REPORTS

FAULT AND EARTHQUAKE STUDIES
- FIELD SURVEYS
- DATA EVALUATION
- REPORTS

GRAVITY
- REPORTS

WATER RESOURCES
FIELD STUDIES
- a. RECONNAISSANCE
- b. DRILLING AND TESTING
  - i. VALLEY-FILL AQUIFER
  - ii. CARBONATE AQUIFER

DATA EVALUATION
- a. VALLEY
- b. CARBONATE
- c. OB
- d. WATER MANAGEMENT PLANNING

WATER APPROPRIATIONS
- a. SURVEYS
- b. HEARING PREPARATION

- REPORTS ▲

AGGREGATE RESOURCES
- FIELD STUDIES
- DATA AND LAB ANALYSES
- REPORTS

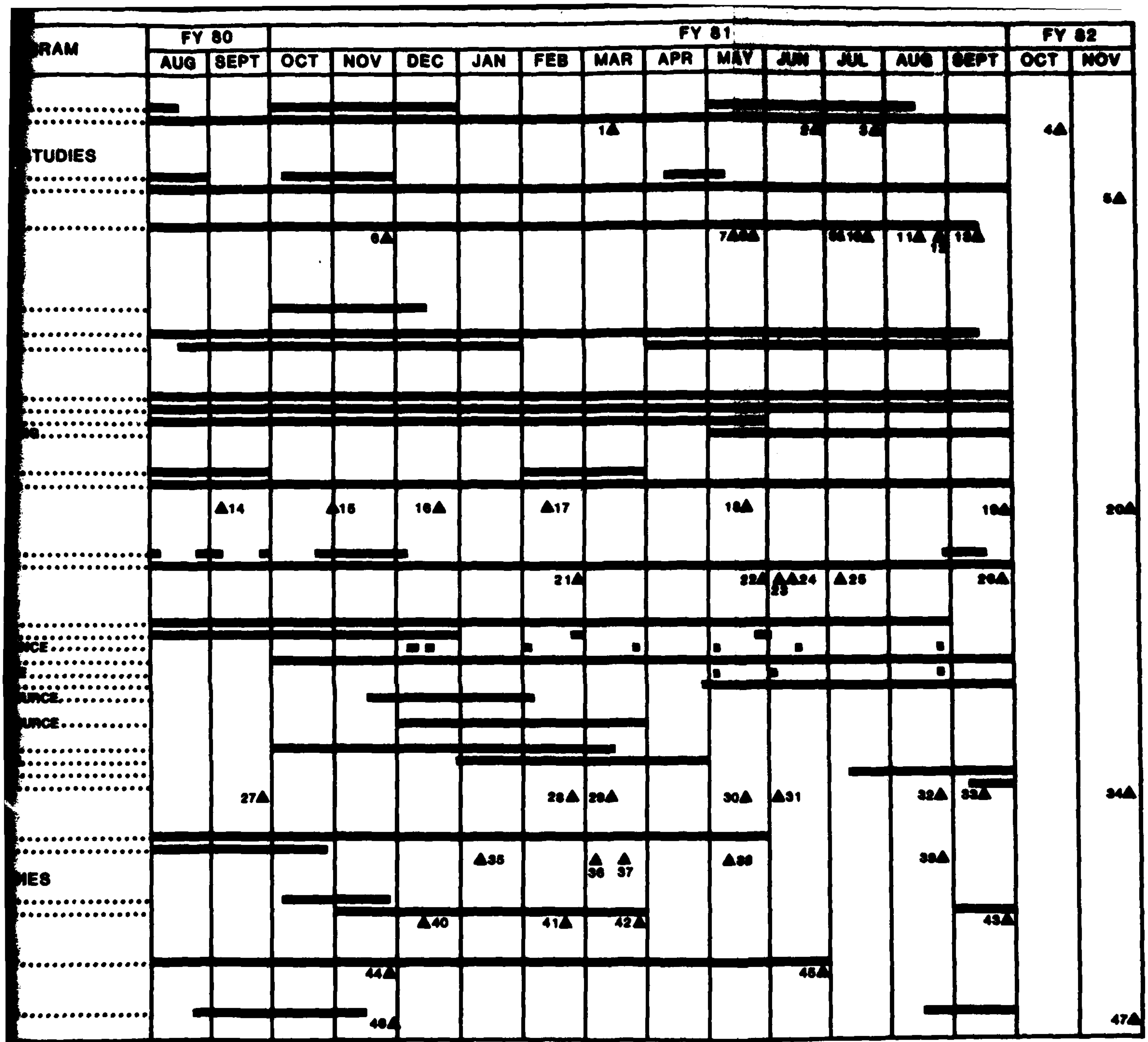
SYSTEM SITINGS
- SHELTER LAYOUTS-1:62,500
- IOC SHELTER LAYOUTS-1:9600
- DTN/ASC FIELD RECONNAISSANCE
- DTN/ASC SITING STUDIES
- OBTS FIELD RECONNAISSANCE
- OBTS SITING STUDIES
- OB SITES ENVIRONMENTAL RESOURCE INVENTORIES-FIELD SURVEYS
- OB SITES ENVIRONMENTAL RESOURCE INVENTORIES-DATA EVALUATION
- IOC VALLEYS FIELD SURVEYS
- IOC VALLEYS DATA EVALUATION
- DTN/OBTS FIELD SURVEYS
- DTN/OBTS DATA EVALUATION
  REPORTS

TOPOGRAPHIC MAPPING
- FIELD WORK
- AERIAL PHOTOS
- MAPS

OPERATIONAL BASE STUDIES
- FIELD STUDIES
- DATA EVALUATION
- REPORTS

MINERAL RESOURCES
- MINERAL SURVEYS
- REPORTS

EXECUTIVE SUMMARY
- DATA EVALUATION
- REPORTS



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BMO/AFRCE-MX

FY 81 GEOTECHNICAL INVESTIGATIONS

6 NOV 81

mineral resource surveys were carried out by mining geologists and economists at Ertec Rocky Mountain, Denver, Colorado.

Although each of the programs is discussed separately in this Executive Summary, a number of the programs were interrelated and required an integrated and coordinated effort of a number of tasks. For example, geotechnically suitable area boundaries determined from the Verification program were drawn on the 1:62,500 scale topographic maps which had been produced. These maps were then used in deployment area layout studies which also utilized data from the water resources studies and mineral resources surveys. The results of the layouts were used in determining the quantities of water needed for water appropriations. The layouts were then transferred to the 1:9600 scale topographic maps which were used for the environmental field surveys in the IOC valleys. Virtually all the major and support programs performed in FY 81 had similar multidiscipline involvement and application.

The status of the four major programs and two of the support programs at the end of FY 81 are summarized in Table 1-2. Several significant points are:

- o Verification field studies were completed for eight valleys in Utah, but reports were completed for only two valleys.
- o Verification field studies were completed for 27 valleys in Nevada, but reports were completed for only seven valleys.
- o Valley-fill drilling and testing to determine availability of water was completed in 18 valleys, and modeling was completed in six valleys. At the end of FY 81, modeling was in progress in 12 valleys.

VALLEY	SITING STUDIES: 26 SEPT 80 1:62500 MPS LAYOUTS ①	SITING STUDIES: 15 MAY 81 1:62500 MPS LAYOUTS ②	VERIFICATION STUDIES: BASIC VERIF FIELD WORK	VERIFICATION STUDIES: DATA GAP STUDIES	VERIFICATION STUDIES: REPORT	AGGREGATE RESOURCES: VALLEY SPECIFIC AGGREGATE RESOURCES (VSARS) FIELD	AGGREGATE RESOURCES: VSAR REPORT	AGGREGATE RESOURCES: DETAILED AGGREGATE RESOURCES STUDY (DARS)
UTAH								
DUGWAY	5	5	C					
FISH SPRINGS FLAT	2	2	C					
PINE	5	5	C		C	C	C	C
SEVIER DESERT	4	2	C					
SEVIER LAKE ③	1	1						
SNAKE	16	19	C			C	C	
TULE	9	10	C			C	C	
WAH WAH	7	5	C		C	C	C	C
WHIRLWIND	11	12	C			C	C	
NEVADA								
ANTELOPE	7	4	C					
BIG SAND SPRINGS	3	3	C					
BIG SMOKY	13	10	C					
BUTTE	4	9	C					
CAVE	2	3	C	C	C	C	C	
COAL	6	6	C	C		C	C	
DELAMAR	4	3	C		C	C	C	C
DRY LAKE	10	10	C		C	C	C	C
GARDEN	6	6	C	C		C	C	
HAMLIN	8	10				C	C	
HOT CREEK	4	6	C					
JAKES	2	3	C					
KOBEH	6	5	C					
LAKE	6	7	C		C	C	C	
LITTLE SMOKY	3	4	C					
LONG	1	4	C					
MONITOR	3	6	C					
MULESHOE	2	3	C	C	C	C	C	C
NEWARK	1	5	C					
PAHROC	1	3	C		C	C	C	
PENOYER	4	5	C					
RAILROAD	19	13	C					
RALSTON	9	9	C		C ④			
REVEILLE	2	3	C					
SPRING	3	4	C					
STEPTOE ③		2	C			C	C	
STONE CABIN	7	8	C					
WHITE RIVER	8	12	C	C		C	C	

EXPLANATION

C WORK COMPLETED

I IN--PROCESS

P/C PARTIAL COMPLETION

1. NUMBER OF SITABLE CLUSTERS BASED ON 23 SHELTERS PER CLUSTER, 5200' SPACING, 2/3 HEX, LINEAR TRUNK CRN, PRIOR TO COMPLETION OF VERIFICATION STUDIES.
2. NUMBER OF SITABLE CLUSTERS BASED ON 23 SHELTERS PER CLUSTER, 5200' SPCAING, 2/3 HEX, DIRECT CONNECT CRN, MAJORITY OF VERIFICATION STUDIES COMPLETED.
3. VALLEY NO LONGER CONSIDERED IN SITING STUDIES.
4. SOUTHERN HALF
5. SOUTHERN PORTION
6. WESTERN PORTION

AGGREGATE RESOURCES			WATER RESOURCES				TOPOGRAPHIC MAPS		GRAVITY REPORTS
VALLEY SPECIFIC AGGREGATE RESOURCES (VSARS) FIELD	VSAR REPORT	DETAILED AGGREGATE RESOURCES STUDY (DARS)	VALLEY FILL DRILLING/ TESTING	CARBONATE DRILLING TESTING	MODELING	WATER MANAGEMENT PLAN	1:9600 SCALE MAPS	1:62500 SCALE MAPS	
			C						C
					I				
C	C	C	C		C	C	C		C
									C
C	C				I			C [illegible]	C [illegible]
C	C		C						
C	C	C	C		C	C	C		C
C	C		C						C
			C						C
									C
C	C		C		I	C	C		C
C	C		C	C	I	C		C	C
C	C	C	C		C	C	C		C
C	C	C	C	C	C	C	C		C
C	C		C		I	C		C	C
C	C		C		I	C	C		C
			C						C
C	C				I	C	C		C
					I				
C	C	C	C		C	C	C		C
C	C				C	C	C		C
					I			C	
			C		I			C	
									C
			C						
			C		I	C			C
C	C			C					
C	C		C		I				C

HELTERS
TRUNK
STUDIES.
HELTERS
CONNECT
MPLETED.
UDIES.

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STATUS OF MAJOR GEOTECHNICAL INVESTIGATIONS, DDA

8 NOV 81 TABLE 1-8

, 2

- o Topographic maps at a scale of 1:9600 were completed for nine valleys and topographic maps at a scale of 1:62,500 were completed for four valleys and part of another valley.
- o Gravity reports were completed for 21 valleys.

Table 1-3 summarizes the studies that were performed at the OB site. As can be seen from examining the table, this one support task consisted of a number of subtasks involving a variety of disciplines from the four Ertec offices.

MOB/DAA SITES (1)	PRELIMINARY SITING STUDIES	PRELIMINARY GEOTECHNICAL STUDIES	VALLEY FILL DRILLING/TESTING
NEVADA ● COYOTE SPRING	C	C	C
UTAH ● BERYL	C	C	C
UTAH ● MILFORD (North and South)	C	C	C
NEW MEXICO ● CANNON AFB	–	–	–

OBTS/DTA SITES	OBTS/DTA SITING	GEOTECHNICAL RECONNAISSANCE	ENVIRONMENTAL SURVEYS
NEVADA ● COYOTE SPRING MOB	C	C	C
UTAH ● BERYL MOB	C	C	C (2)
UTAH ● MILFORD (Central and South)	C	C	C
NEW MEXICO ● CANNON MOB	C	C	–

C WORK COMPLETED
P/C PARTIALLY COMPLETED

NOTES:

1. MOB/DAA sites are those developed by the OB working group 20 AUG 80. More detailed siting studies since then have resulted in changes in the location of MOB/DAA sites. Portions of the new sites are not covered by the studies listed in the table.
2. Preferred site only.

WATER RESOURCES			TOPOGRAPHIC MAPPING	MINERAL SURVEY
VALLEY FILL DRILLING/TESTING	CARBONATE DRILLING/TESTING	MODELING	AT 1:[illegible] SCALE MAP	
C	C	P/C	C	C
C	C	P/C	C	C
C	C	P/C	C	C
–	–	–	–	–

ENVIRONMENTAL SURVEYS	TOPOGRAPHIC MAPPING	MINERAL SURVEY
C	–	–
C ②	–	–
C	–	–
–	–	–

OB working
ies since then
OB/DAA sites.
the studies listed

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BMO/AFRCE-MX

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1 NOV 79

1 V

2.0 VERIFICATION

2.1 VALLEY VERIFICATION PROGRAM

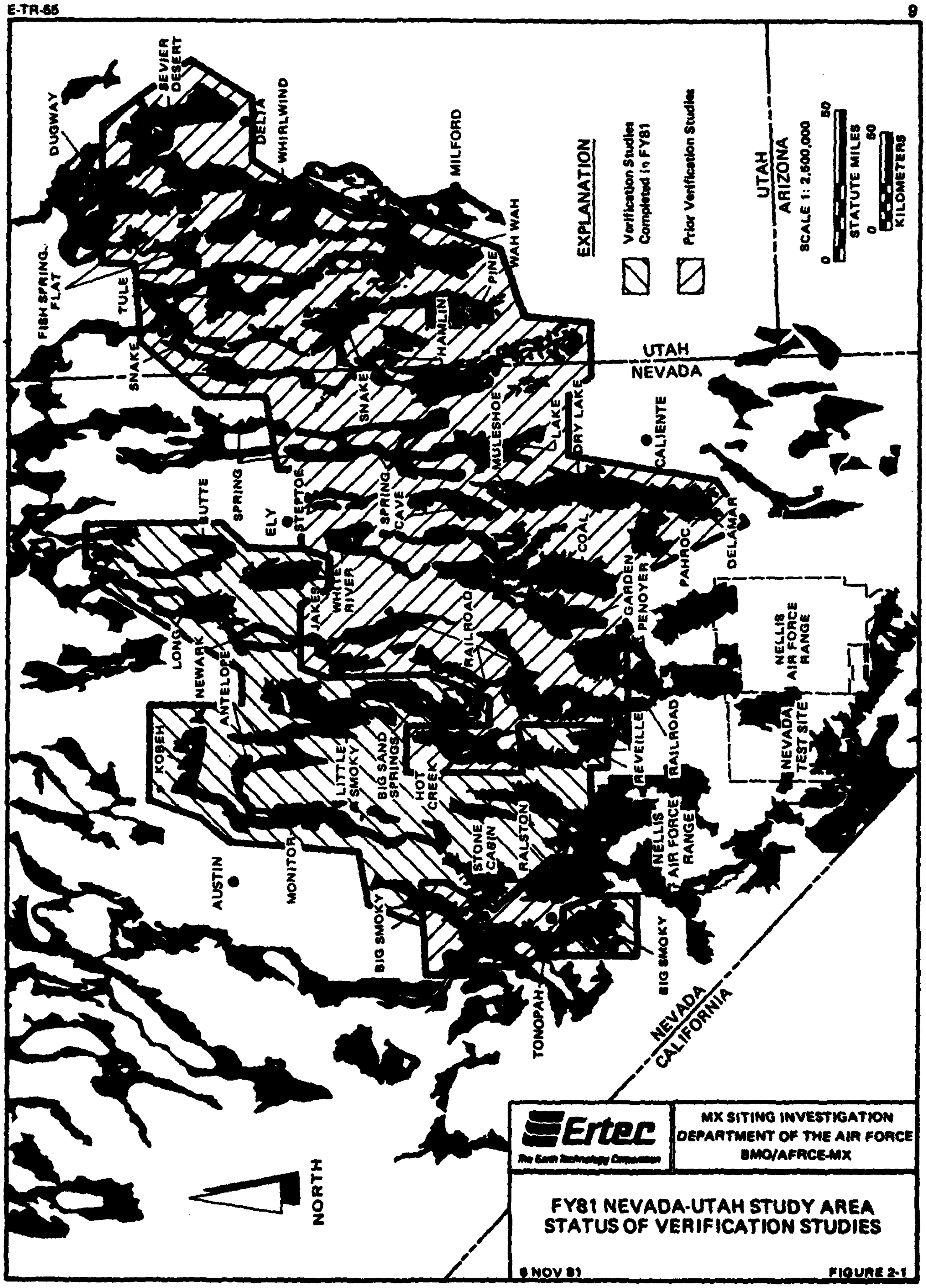
2.1.1 Background

Verification field studies in Nevada and Utah began in October 1978. Prior to this time, approximately 20,000 mi^2 (51,800 km^2) of suitable area in Nevada and Utah had been identified during literature-based Screening studies. About 7700 mi^2 (19,900 km^2) of this area were selected as the study area during FY 79. At that time, field studies were performed and reports prepared for portions of seven valleys. During FY 80, field Verification studies were performed in additional valleys so that by the end of FY 80, Verification field studies had been completed in 24 geographical valleys. During FY 81, field Verification studies were completed in 12 more valleys bringing the total to 36 geographical valleys (Figure 2-1).

Reports incorporating results from Verification studies and preceding Characterization studies in Dry Lake and Ralston valleys were published during FY 80. Verification reports for Delamar, Lake, Muleshoe, Pahroc, Pine, and Wah Wah valleys were published during FY 81. A report on Cave Valley was completed in the first month of FY 82. A revised map of suitable area based on the final Verification data is presented as Drawing 2-1.

2.1.2 Objectives

The Verification studies in Nevada-Utah included the objectives that follow.



FY81 NEVADA-UTAH STUDY AREA
STATUS OF VERIFICATION STUDIES

5 NOV 81 FIGURE 2-1

1. Verify and refine boundaries of suitable area;
2. Obtain geologic, geophysical, and engineering data for preliminary design studies;
3. Identify problem areas where additional field work will be necessary; and
4. Recommend additional sites for study in Nevada-Utah to ensure sufficient suitable area to deploy the MX system utilizing the multiple protective shelter mode.

Verification studies consisted of a combination of geologic, geophysical, and soils engineering investigative techniques designed to differentiate suitable and unsuitable areas and obtain basic information on soil and terrain characteristics. The geotechnical parameters evaluated and techniques used are shown schematically in Table 2-1. Table 2-2 lists the type and number of geotechnical activities performed to date in each valley.

Prior to starting the Verification field studies, a program plan was developed, logistics were planned, and photogeologic mapping initiated. Access was approved through state and district offices of the U.S. Bureau of Land Management (BLM) in Nevada and Utah via the Army Corps of Engineers (COE) in Sacramento, California. At BLM's request, all field activities were performed along existing roads or trails to minimize disturbance to the sites. Activity locations were changed in those few instances where a potential environmental or archaeological disturbance was identified.

OBJECTIVES → **VERIFICATION OF SU**

DATA FOR EVALUATIONS → **TERRAIN PARAMETERS** | **GEOLOGIC HAZAR**

FIELD TECHNIQUES AND APPLICATIONS →

Geologic mapping

- Identification and limits of areas with slopes greater than 5% and 10% grade

Geologic mapping

- Identification of faults a lineaments

UITABLE AREA FOR MX DEPLOYMENT

ARD

50'/150' DEPTH TO ROCK

Geologic mapping

- Surface limits of rock
- Depth to rock from topographic and geologic interpretation
- Geomorphic expression and erosion history

Seismic refraction surveys

- Subsurface projection of rock limits
- Delineation of high velocity layers from p–wave velocities (> 7000 fps)

Borings

- Occurrence of rock

Existing data

- Published literature

50'/150' DEPTH TO GROUND WATER

Geologic mapping

- Obtain water depths from wells in study area
- Monitoring wells
- Occurrence of ground water

Electrical resistivity/ seismic refraction surveys

- Provide supplemental data to support presence or absence of ground water

Existing data

- Published literature

EXTENT AND CHARACTERISTICS OF SOILS

Geologic mapping

- Extent of surficial soil units
- Surficial soil types

Borings

- Identification of subsurface soil types
- In situ soil density and consistency
- Samples for laboratory testing

Trenches and test pits

- Identification of surface and subsurface soil types
- Degree of induration and cementation of soils
- In situ moisture and density of soil
- Samples for laboratory testing

Cone penetrometer tests

- In situ soil strength

Laboratory tests

- Physical properties
- Engineering properties – shear strength, compressibility
- Chemical properties

GEO PR

Seismic re

- Compressio
- Layering of

Electr

- Electrical e
- Layering of

12 1

CHARACTERISTICS OF BASIN FILL

EXTENT AND CHARACTERISTICS OF SOILS

Geologic mapping

- Extent of surficial soil units
- Surficial soil types

Borings

- Identification of subsurface soil types
- In situ soil density and consistency
- Samples for laboratory testing

Trenches and test pits

- Identification of surface and subsurface soil types
- Degree of induration and cementation of soils
- In situ moisture and density of soil
- Samples for laboratory testing

Cone penetrometer tests

- In situ soil strength

Laboratory tests

- Physical properties
- Engineering properties – shear strength, compressibility
- Chemical properties

GEOPHYSICAL PROPERTIES

Seismic refraction surveys

- Compressional wave velocities
- Layering of soil

Electrical resistivity surveys

- Electrical conductivity of soils
- Layering of soil

ROAD DESIGN DATA

Trenches and test pits

- Identification of soil types
- In situ soil density and moisture

Cone penetrometer tests

- In situ soil strength
- Thickness of low strength surficial soil

Laboratory tests

- Physical properties
- Compaction and CBR data
- Suitability of soils for use as road subgrade, subbase or base

Existing data

- Suitability of soils for use as road subgrade, subbase, or base
- Behavior of compacted soils

EXCAVATABILITY AND STABILITY

Borings

- Subsurface soil types
- Presence of cobbles and boulders
- In situ density of subsurface soils
- Stability of vertical walls

Trenches and test pits

- Subsurface soil types
- Subsurface soil density and cementation
- Stability of vertical walls
- Presence of cobbles and boulders

Laboratory tests

- Physical properties
- Engineering properties

Geologic mapping

- Distribution of geologic units

Seismic refraction surveys

- Excavatability

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TICS OF BASIN FILL

PRELIMINARY GEOTECHNICAL CONSIDERATIONS AND RECOMMENDATIONS

ROAD DESIGN DATA

Trenches and test pits

- Identification of soil types
- In situ soil density and moisture

Cone penetrometer tests

- In situ soil strength
- Thickness of low strength surficial soil

Laboratory tests

- Physical properties
- Compaction and CBR data
- Suitability of soils for use as road subgrade, subbase or base

Existing data

- Suitability of soils for use as road subgrade, subbase, or base
- Behavior of compacted soils

EXCAVATABILITY AND STABILITY

Borings

- Subsurface soil types
- Presence of cobbles and boulders
- In situ density of subsurface soils
- Stability of vertical walls

Trenches and test pits

- Subsurface soil types
- Subsurface soil density and cementation
- Stability of vertical walls
- Presence of cobbles and boulders

Laboratory tests

- Physical properties
- Engineering properties

Geologic mapping

- Distribution of geologic units

Seismic refraction surveys

- Excavatability

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FIELD TECHNIQUES
VERIFICATION STUDIES

6 NOV 81

TABLE 2-1

4

VALLEY	GEOLOGIC MAPPING STATIONS	SEISMIC REFRACTION MEASUREMENTS	ELECTRICAL RESISTIVITY SOUNDINGS	GRAVITY SURVEY	BORINGS	TRENCHES AND TEST PITS	CONE PENE-TROMETER TESTS (CPT)	FIELD CBR TESTS
ANTELOPE	64	14	12	YES	5	28	57	2
BIG SAND SPRINGS	77	16	14	YES	6	24	50	2
BIG SMOKY	203	28	28	YES	13	66	131	28
BUTTE	118	23	23	YES	6	35	71	2
CAVE	56	10	10	YES	4	16	20	0
COAL	83	15	15	YES	5	35	62	0
DELAMAR	79	13	12	YES	5	24	37	0
DRY LAKE	60	17	0	YES	18	47	84	0
DUGWAY	69	21	20	YES	5	27	48	0
FISH SPRINGS FLAT	59	17	17	YES	4	14	29	0
GARDEN	45	16	15	YES	6	34	43	0
HAMLIN	101	31	30	YES	9	54	91	0
HOT CREEK	61	12	9	YES	5	35	63	8
JAKES	49	17	16	YES	5	17	33	2
KOBEH	134	18	18	YES	4	28	51	4
LAKE	123	22	20	YES	7	54	102	2
LITTLE SMOKY	80	11	10	YES	4	22	39	2
LONG	85	18	17	YES	2	12	26	0
MONITOR	97	19	18	YES	4	27	48	2
MULESHOE	48	10	9	YES	3	17	24	0
NEWARK	123	26	26	YES	6	28	55	2
PAHROC	49	7	7	YES	3	18	28	0
PENOYER	90	18	15	YES	6	22	41	0
PINE	98	23	22	YES	10	44	86	15
RAILROAD	296	42	41	YES	14	88	171	19
RALSTON	112	30	13	YES	19	43	64	4
REVEILLE	43	12	12	YES	.5	20	36	1
SEVIER DESERT	99	25	24	YES	10	60	101	0
SNAKE	255	58	56	YES	18	91	177	0
SPRING	134	29	27	YES	9	42	71	2
STEPTOE	45	12	11	YES	4	23	42	4
STONE CABIN	84	23	22	YES	8	39	73	7
TULE	221	49	46	YES	11	73	122	0
WAH WAH	73	21	21	YES	7	40	72	8
WHIRLWIND	180	37	36	YES	12	66	122	0
WHITE RIVER	141	44	43	YES	12	63	123	0
TOTALS	3722	804	735		274	1376	2493	116

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VERIFICATION
FIELD ACTIVITIES TO DATE

6 NOV 81

TABLE 2-2

2.1.3 Scope

The FY 81 Verification program consisted of three major elements:

1. Reconnaissance level Verification studies;
2. Basic Verification studies; and
3. Data Gap studies.

2.1.3.1 Reconnaissance Level Verification Studies

Reconnaissance level Verification studies were performed during the first quarter of FY 81 in the six northern valleys; Butte, Jakes, Kobeh, Long, Monitor, and Newark. The studies were necessary to collect preliminary data on the rock-basin fill line and areas of shallow rock and shallow water to support preliminary layout studies. Basic Verification studies for the six northern valleys were then completed later in FY 81.

2.1.3.2 Basic Verification Studies

The basic Verification studies were performed in new valleys as well as in portions of the FY 80 Verification valleys in which field work had not previously been completed. By the end of FY 81, Verification field studies had been completed in the following valleys:

1. Dugway	13. Dry Lake	25. Railroad
2. Tule	14. Delamar	26. Sevier Desert
3. Fish Springs	15. Muleshoe	27. Antelope
4. Whirlwind	16. Pahroc	28. Little Smoky
5. Snake	17. Garden	29. Big Sand Springs
6. Hamlin	18. Coal	30. Ralston
7. Pine	19. Reveille	31. Butte
8. Wah Wah	20. Big Smoky	32. Jakes
9. Spring	21. Penoyer	33. Kobeh
10. Cave	22. Steptoe	34. Long
11. Lake	23. Hot Creek	35. Monitor
12. White River	24. Stone Cabin	36. Newark

2.1.3.3 Data Gap Studies

Evaluation of the data collected in FY 80 and the first quarter of FY 81 resulted in identifying certain valleys in which additional field work was necessary to more accurately define the suitable area boundaries. These studies were termed "data gap studies" and consisted of drilling ground-water observation wells and performing seismic refraction surveys.

The data gap studies were performed in Cave, Muleshoe, Garden, Coal, and White River valleys.

2.1.4 Results

2.4.1.1 Suitable Area

As in FY 80, the Verification studies resulted in changes to the boundaries of the suitable area of many valleys. The presence of shallow rock, shallow ground water, and/or adverse terrain accounted for most of the changes (Table 2-3).

2.1.4.2 Basin-Fill Material Characteristics

A. Surficial Soils

Surface soils classified were predominantly coarse-grained (granular) consisting of sand and gravel. Fine-grained soils (silt and clay) exist over limited portions of most sites. The surficial soils were combined into three categories based on their physical and engineering properties:

1. Silty sand and clayey sand: Predominant surficial soil occurring primarily in alluvial fans which extend from the basin margins to the basin center or playa edge.
2. Gravel and gravelly sand: These are the second most predominant surficial soil type occurring primarily in alluvial

VALLEY	STATE	GEOTECHNICAL SUITABLE AREA (MI^2) – HORIZONTAL SHELTER		
		BEGINNING AREA [a]	RESULTING AREA [b]	AREA CHANGE
ANTELOPE	NEVADA	245	125	– 120
BIG SAND SPRINGS	NEVADA	235	210	– 25
BIG SMOKY	NEVADA	680	693	+ 13[d]
BUTTE	NEVADA	182	295	+ 113
CAVE	NEVADA	135	115	– 20
COAL	NEVADA	275	240	– 35
DELAMAR	NEVADA	180	154	– 26
DRY LAKE	NEVADA	360	310	– 50
DUGWAY	UTAH	170	161	– 9
FISH SPRINGS FLAT	UTAH	155	135	– 20
GARDEN	NEVADA	230	200	– 30
HAMLIN	NEVADA-UTAH	425	335	– 90
HOT CREEK	NEVADA	185	252	+ 67[d]
JAKES	NEVADA	180	157	– 23
KOBEH	NEVADA	365	211	– 154
LAKE	NEVADA	460	267	– 193
LITTLE SMOKY	NEVADA	340	254	– 86
LONG	NEVADA	114	230	+ 116
MONITOR	NEVADA	266	280	+ 14
MULESHOE	NEVADA	100	76	– 24
NEWARK	NEVADA	150	150	0[c]
PAHROC	NEVADA	105	103	– 2
PENOYER	NEVADA	285	265	– 20
PINE	UTAH	165	278	+ 113[d]
RAILROAD	NEVADA	790	748	– 42
RALSTON	NEVADA	420	375	– 45
REVEILLE	NEVADA	200	145	– 55
SEVIER DESERT	UTAH	225	477	+ 252[d]
SNAKE	NEVADA-UTAH	625	656	+ 31[d]
SPRING	NEVADA	210	250	+ 40[d]
STEPTOE	NEVADA	105	90	– 15
STONE CABIN	NEVADA	390	397	+ 7
TULE	UTAH	540	391	– 149
WAH WAH	UTAH	50	234	+ 184[d]
WHIRLWIND	UTAH	430	449	+ 19[d]
WHITE RIVER	NEVADA	625	485	– 140
	TOTALS	10, 597	10, 193	– 404

NOTES:

a. FROM INTERMEDIATE SCREENING

b. AT END OF FY 81

c. BASED ON RECONNAISSANCE VERIFICATION MAPPING.

d. VALLEY GEOGRAPHIC BOUNDARIES WERE EXPANDED

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CHANGES IN GEOTECHNICAL SUITABLE AREA FOR HORIZONTAL SHELTER BASING MODE

6 NOV 81 TABLE 2-3

fans near the valley margins. They consist of sandy, silty, and clayey gravel and sand with appreciable gravel content.

3. Silt and clay: These are the least extensive surficial soils occurring primarily in the lacustrine deposits in the center of the basin. These soils consist of sandy silt and clay and silty clay with appreciable amounts of fine sand.

B. Subsurface Soils

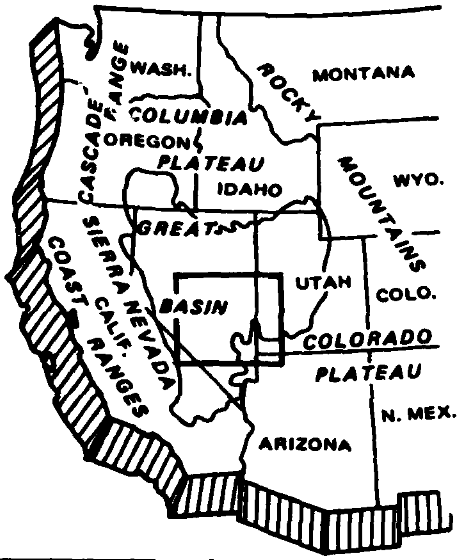
Subsurface soils obtained during the boring program (approximate depth of investigation of 160 feet [49 m]) were predominantly coarse-grained (gravel and sand). Fine-grained soils (silt and clay) are estimated to occur in about ten to 15 percent of the subsurface.

The coarse-grained soils are generally dense to very dense below depths of approximately 5 feet (15 m). They exhibit low compressibilities and possess moderate to high shear strengths. The fine-grained soils exhibit low to high plasticity and generally contain appreciable amounts of fine sand. Variable calcium carbonate cementation exists in the subsurface soils.

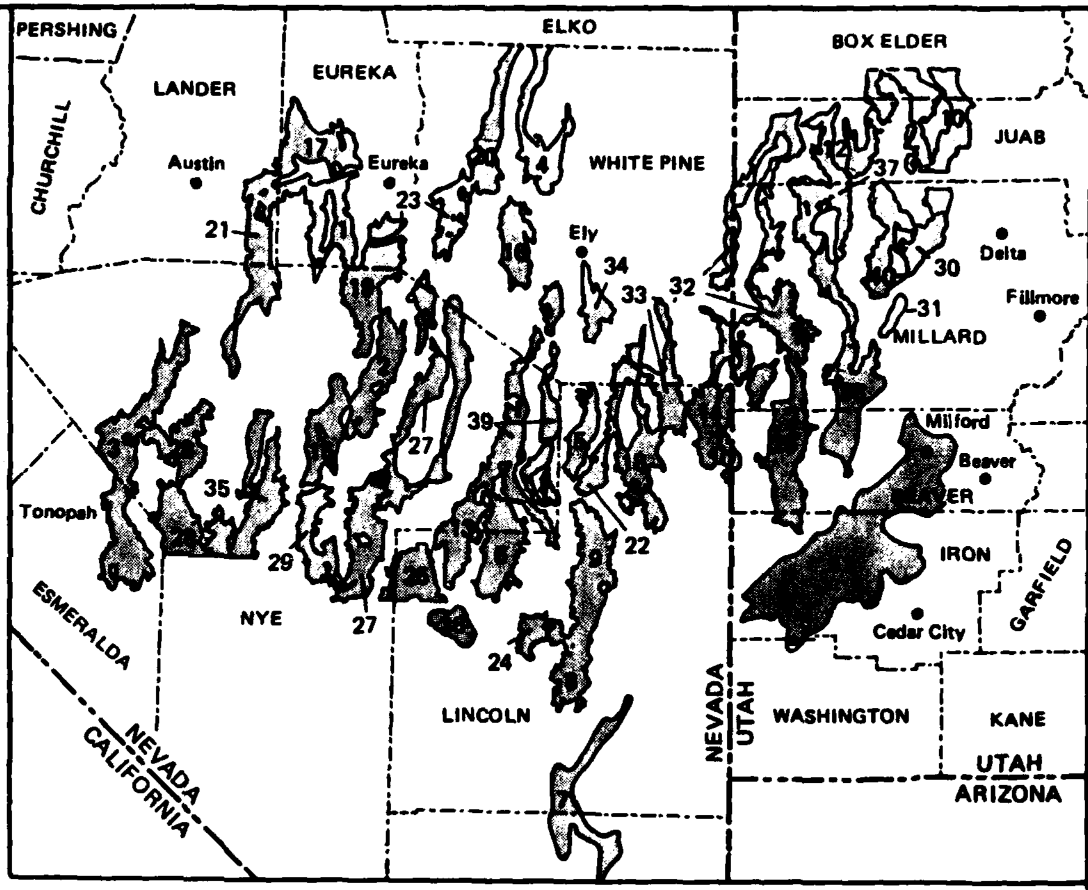
2.2 FAULT AND EARTHQUAKE HAZARDS PROGRAM

2.2.1 Background and Objectives

The Nevada-Utah siting region is located in the Great Basin physiographic province which is characterized by areas of high seismic flux, large earthquakes, and active faults. The most significant fault and earthquake hazards within the MX siting region are the potential of ground rupture immediately beneath facilities and the strong ground motion which may damage MX missile facilities and transportation and communications networks. The areas analyzed are depicted in Figure 2-2.



A. INDEX MAP SHOWING LOCATION OF FAULT STUDY AREA AND MAJOR PHYSIOGRAPHIC PROVINCES.



B. ENLARGEMENT OF SHADED AREA ON INDEX MAP. SHADED AREAS REPRESENT VALLEYS STUDIED IN DETAIL.

1. ANTELOPE VALLEY
2. BIG SAND SPRINGS VALLEY
3. BIG SMOKY VALLEY
4. BUTTE VALLEY
5. CAVE VALLEY
6. COAL VALLEY
7. COYOTE-KANE VALLEY
8. DELAMAR VALLEY
9. DRY LAKE VALLEY
10. DUGWAY VALLEY
11. ESCALANTE DESERT
12. FISH SPRINGS FLAT
13. GARDEN VALLEY
14. HAMLIN VALLEY
15. HOT CREEK VALLEY
16. JAKES VALLEY
17. KOBEH VALLEY
18. LAKE VALLEY
19. LITTLE SMOKY VALLEY
20. LONG VALLEY
21. MONITOR VALLEY
22. MULESHOE VALLEY
23. NEWARK VALLEY
24. PAHROC VALLEY
25. PENOYER (SAND SPRING VALLEY)
26. PINE VALLEY
27. RAILROAD VALLEY
28. RALSTON VALLEY
29. REVEILLE VALLEY
30. SEVIER DESERT
31. SEVIER LAKE
32. SNAKE VALLEY
33. SPRING VALLEY
34. STEPTOE VALLEY
35. STONE CABIN VALLEY
36. TIKABOO VALLEY
37. TULE VALLEY
38. WAH WAH VALLEY
39. WHITE RIVER VALLEY
40. WHIRLWIND VALLEY

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AREAS STUDIED FOR YOUNG FAULTS WITHIN THE NEVADA-UTAH MX DEPLOYMENT REGION

6 NOV 81

FIGURE 2-2

The main objective of the FY 81 fault and earthquake hazards investigation was to determine the location of faults and lineaments to minimize earthquake-related hazards to engineered structures and facilities of the MX system. Other objectives of the study included estimation of maximum credible earthquakes, determination of age of last movement along individual faults, and assessment of earthquake recurrence intervals.

2.2.2 Scope

The scope of the FY 81 fault and earthquake hazards study included:

1. Analysis of color stereo aerial photographs for faults and lineaments,
2. Field verification of faults and lineaments,
3. Literature survey,
4. Magnetometer surveys across selected faults and lineaments,
5. Staking activities for FY 82 trench localities,
6. Map compilation, and
7. Report writing.

2.2.3 Results

Faults identified during FY 80 and FY 81 studies in the MX siting area have been compiled on a series of 1:62,500 maps utilized for siting studies. These faults, as well as those identified in the literature, have been depicted on a regional map of the MX deployment area in Utah and Nevada at a scale of 1:500,000 in Drawing 2-2.

Quaternary faults within the study area generally form linear trends subparallel to the regional northerly to northeasterly geologic structural fabric. In cross section, most valleys consist of asymmetric, tilted, fault blocks characterized by a relatively continuous, large displacement fault zone on one side of the valley and shorter, discontinuous faults widely scattered throughout the valley. Lengths of major fault zones are up to about 65 miles (105 km) and comprise single surface breaks and zones that are up to 5 miles (8 km) wide. Faults that have trends transverse to the regional structure are generally scarce but where they exist they generally strike northeasterly. All faults mapped have dip-slip separation representative of normal faulting.

In Nevada, late Pleistocene fault scarps are present in every valley studied and post Bonneville-Lahonton (less than 15,000 years) fault scarps are present in approximately one-third of the valleys.

In Utah, late Pleistocene fault scarps are not as common but post Bonneville-Lahonton fault scarps occur in about two-thirds of the valleys studied. The higher ratio of post Bonneville-Lahonton scarps to Pleistocene fault scarps in Utah may be attributed to removal of the older scarps by erosion associated with late Quaternary pluvial-lake fluctuations or to increased tectonic activity.

The ubiquity of fault scarps throughout the MX deployment area, their concordance with the regional trends, and the continuous

range of ages spanning the Quaternary Period indicate that the study area has been tectonically active throughout the Quaternary and presently has earthquake and fault-rupture hazards. The faults within the study area are similar in characteristics to faults in western and north-central Nevada where seismicity historically has been high. This suggests that comparable earthquake (7 to 7.75 magnitude) and fault-rupture hazards may be present in east-central Nevada and west-central Utah even though large magnitude earthquakes have not occurred there within historic time. Geomorphic characteristics of fault scarps suggest many major faults have remained dormant for many thousands of years before renewed rupturing with substantial surface displacements. This indicates that large earthquakes have recurrence intervals of several thousand years and perhaps much greater than 10,000 years.

2.3 GRAVITY PROGRAM

2.3.1 Background, Scope, and Objectives

Gravity surveys have been included in the MX siting investigations since 1977. The gravity data are obtained for the purpose of estimating the gross structure and shape of the basins and the thickness of the valley fill. These estimates are valuable in studying ground-water regimes and for modeling by the MX Survivability and Hardness community. Gravity surveys also have the potential of detecting areas of shallow rock that might exist between the widely spaced borings and seismic refraction lines.

Implementation of the gravity program is a joint effort between the Defense Mapping Agency (DMA) and Ertec. The Defense Mapping Agency, Hydrographic/Topographic Center (DMAHTC) performs the field work to obtain the gravity measurements, and the Defense Mapping Agency, Aerospace Center (DMAAC) calculates the outer zone terrain corrections for each gravity measurement station and provides existing data from its library. Ertec calculates inner zone terrain corrections, where needed, and performs geologic interpretations based on the gravity data.

2.3.2 Status of Field Surveys and Reports

During FY 81, the field data acquisition program was completed. Data have been acquired, or were available from the DMAAC library for 36 valleys in the Nevada-Utah siting area.

Prior to FY 80, data were obtained along widely spaced profiles in some of the valleys. During FY 80 and 81, data were obtained on an approximately evenly distributed grid within the valleys, including those that previously had only profiles.

The status of reports covering the gravity surveys is shown in Table 2-4.

2.3.3 Results of FY 81 Program

The gravity interpretations have demonstrated a wide diversity in the depths, shapes, and complexity of structure in the basins in Nevada and Utah. Relatively wide, shallow pediments are interpreted along the flanks of some valleys, whereas the bedrock in others appears to be at great depth very near the

REPORTS ISSUED

PRIOR TO 1981	DURING 1981
NEVADA	**NEVADA**
BIG SAND SPRINGS (LIBRARY*)	DELAMAR
COAL (PROFILES)	LAKE
DRY LAKE	MULESHOE
GARDEN (PROFILES)	PAHROC
HAMLIN (PROFILES)	RALSTON
HOT CREEK (LIBRARY*)	SPRING
WHITE RIVER (PROFILES)	BIG SMOKY (LIBRARY*)
UTAH	**UTAH**
SNAKE SOUTH (PROFILES)	DUGWAY
WHIRLWIND (PROFILES)	PINE
	SEVIER DESERT
	WAH WAH

* Report based on existing data in DMAAC Library rather than new field data.

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STATUS OF GRAVITY REPORTS

6 NOV 81 TABLE 2-4

rock outcrop lines. Some valleys are symmetrical in cross section, appearing to be true grabens; others are asymmetrical as though formed by tilted blocks. Many faults are interpreted to be trending across the dominant north-south orientation of the Basin and Range structures.

3.0 WATER RESOURCES PROGRAM

3.1 BACKGROUND AND OBJECTIVES

The MX Water Resources Program was initiated in June 1979 for the purpose of evaluating the availability of water for both the construction and operational phases of the MX project in Nevada and Utah and to assess the effects of these withdrawals on the local water users, the environment, and the aquifers. Six valleys in the siting area were studied during FY 79.

The Water Resources Program was expanded in FY 80 to include field investigations and evaluation of the hydrogeologic conditions in all valleys within the siting area to better quantify the potential effects of MX ground-water withdrawals on the local water users and the environment, to suggest the optimum water-supply system for the project, and to provide information in support of water-appropriation applications. It included field investigations of the hydrogeologic conditions in 23 deployment valleys and one potential OB site valley (Steptoe).

The FY 81 Water Resources Program continued the general approach of updating and expanding the existing data base in the Nevada-Utah siting area in order to identify and quantify aquifer characteristics, ground-water and surface-water regimes, water quality, and water use and appropriations in the region.

3.2 SCOPE

The FY 81 Water Resources Program included the following activities:

- Field investigations in Coyote Spring Valley and Escalante Desert and six northern Nevada valleys that were added to the deployment area during the summer of 1980. The six valleys are Kobeh, Butte, Jakes, Monitor, Newark, and Long.

- Completion of valley-fill drilling and testing in four valleys that were in progress at the end of FY 80, plus, drilling and testing in the Milford, Beryl, and Coyote Spring OB areas and Reveille, Big Sand Springs, Muleshoe, and Coal valleys.

- Completion of carbonate aquifer drilling and testing in two valleys that were in progress at the end of FY 80 plus drilling and testing of two carbonate wells and drilling of one carbonate aquifer monitoring well in Coyote Spring Valley.

- Development of computer numerical models of the ground-water system in nine valleys and the White River regional ground-water flow system and the refinement and update of six models developed in FY 80.

- Application for the appropriation of ground water in the six northern Nevada valleys, and in the Coyote Spring, Ely, and Delta OB sites (Section 3.4).

- Preparation for hearings by the state engineers on the Air Force water-appropriation applications.

- Development of preliminary water management plans for 12 deployment area and two OB valleys in which MX construction was scheduled to begin in 1982 or 1983 based on the 17 March 1981 COE water-use schedules.

A summary of all Water Resources Program field activities to date is shown in Table 3-1. The location of major Water Resources Program field activities is shown in Figure 3-1.

3.3 RESULTS AND CONCLUSIONS

3.3.1 Valley-Fill Aquifer Studies

The following summarizes the results and conclusions of the valley reconnaissance and drilling and testing program.

VALLEY	DRILLED WELLS(1)	AQUIFER PUMP TESTS(2)	WATER QUALITY ANALYSES	WATER LEVEL MEASUREMENTS (4)	DISCHARGE MEASUREMENTS	WATER TABLE MONITORING WELL (5)
NEVADA						
ANTELOPE	0	0	4	38	6	6
BIG SAND SPRINGS	2	1	4	7	4	1
BIG SMOKY	0	2	5	23	2	0
BUTTE	0	0	5	21	6	5
CAVE	2	1	9	14	3	2
COAL	3	1	7	20	1	5
COYOTE SPRING (MOB)	5	3	7	6	9	0
DELAMAR	2	1	4	3	4	0
DRY LAKE	3	1	8	3	5	0
GARDEN	2	1	11	66	8	7
HOT CREEK	4	2	28	36	14	6
JAKES	0	0	3	2	8	0
KOBEH	0	0	8	49	13	5
LAKE	0	0	0	67	0	15
LITTLE SMOKY	0	0	4	20	3	3
LONG	0	0	6	23	3	6
MONITOR	0	0	17	12	22	0
MULESHOE	2	1	5	3	8	0
NEWARK	0	1	15	49	11	5
PAHROC	0	0	0	5	1	0
PENOYER	0	0	6	39	9	6
RAILROAD	4	2	12	64	15	19
RALSTON	0	0	2	24	6	3
REVEILLE	2	1	6	9	6	1
SPRING	2	2	15	88	10	13
STEPTOE	1	1	23	39	16	9
STONE CABIN	0	0	7	25	8	5
WHITE RIVER	1	4	22	112	3	11
UTAH						
DUGWAY	2	0	1	37	1	3
FISH SPRINGS FLAT	0	0	2	85	1	9
ESCALANTE DESERT (AOB)	4	2	32	86	4	0
PINE	2	1	6	3	2	0
SEVIER DESERT	0	1	7	79	0	14
SNAKE(3)	0	5	26	349	7	40
HAMLIN(3)	2	5	23	138	15	16
TULE	4	3	14	190	5	16
WAH WAH	3	1	5	3	0	0
WHIRLWIND	2	1	3	94	2	15
TOTAL	54	44	362	1931	241	246

NOTE:

1. Includes test and observation wells.
2. Includes both drilling and reconnaissance program
3. Straddles Nevada - Utah border
4. Includes multiple measurements at monitoring sites through March 1981
5. Total does not include 7 wells outside water resources study area boundaries

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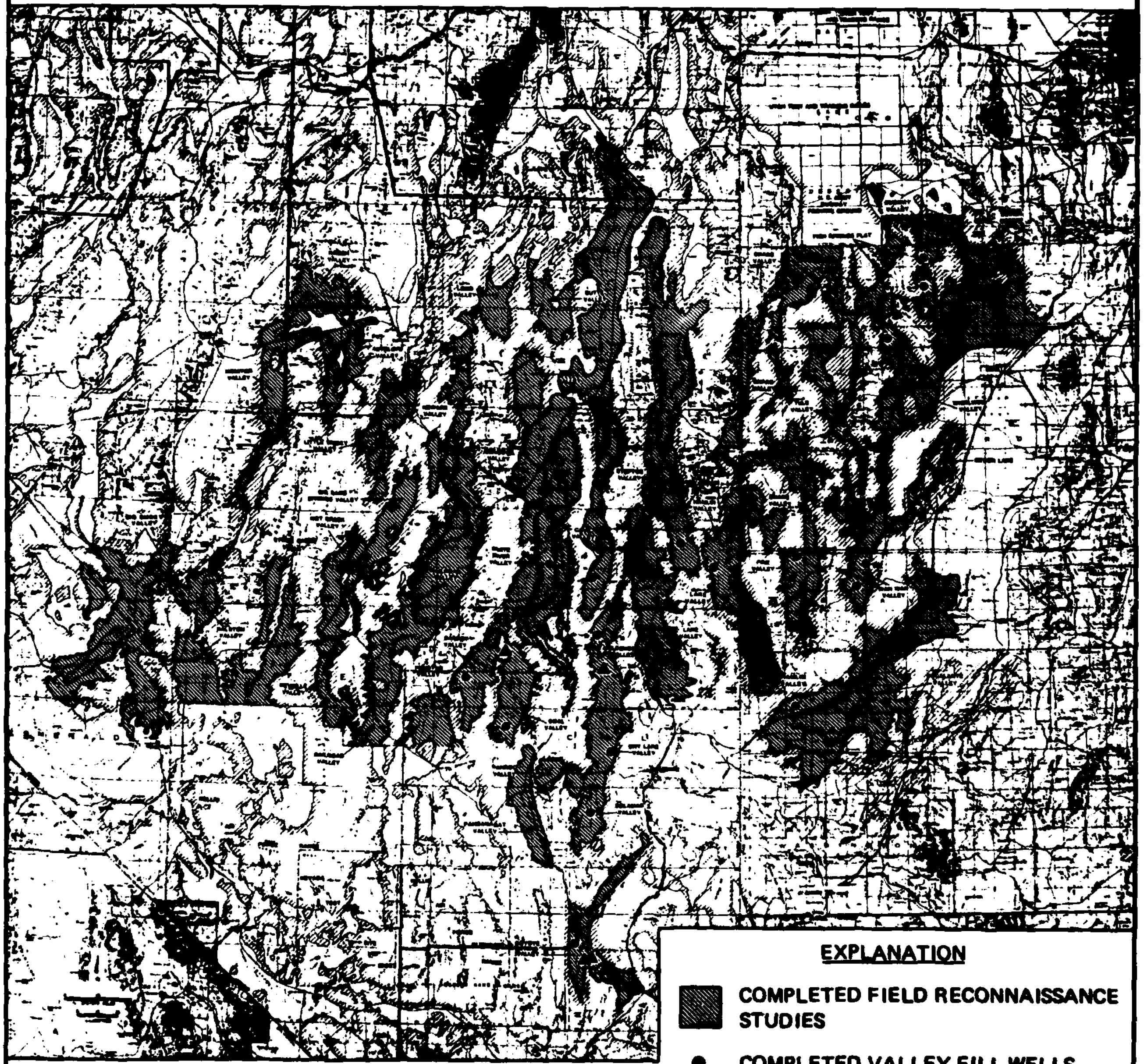
SUMMARY OF MX WATER RESOURCES PROGRAM FIELD ACTIVITIES

6 NOV 81 TABLE 3-1



EXPLANATION

- COMPLETED FIELD RECONNAISSANCE STUDIES
- ● COMPLETED VALLEY-FILL WELLS
- ▲ COMPLETED CARBONATE WELLS

NORTH

0 50 100
STATUTE MILES

0 50 100
KILOMETERS

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WATER RESOURCE FIELD ACTIVITIES
NEVADA – UTAH

6 NOV 81

FIGURE 3-1

o Most of the valleys in the deployment area have sufficient ground-water available in valley-fill aquifers to supply MX construction needs based on state perennial yield estimates, ground-water in storage, and present ground-water rights.

o Approved ground-water rights presently exceed the state estimated perennial yield in Big Smoky, Penoyer, Lake, and Stone Cabin valleys. Alternate sources of water supply for MX would be required in these valleys depending on the State Engineer's ruling on the Air Force applications for ground-water appropriations.

o Ground water of suitable quality for drinking and construction is believed to be present in nearly all of the valleys based on field investigations and available data. Ground water is of generally poorer quality in Dugway, Whirlwind, and Fish Springs Flat valleys, Utah, and would require some treatment for MX domestic purposes.

o Well yields obtained during valley-fill aquifer testing (reconnaissance and drilling programs) ranged from 7 gallons per minute (gpm) (0.44 l/s) to 2200 gpm (139 l/s). Well yields averaged 341 gpm (21.6 l/s) for the test wells drilled by Ertec.

o The transmissivities calculated from valley-fill aquifer tests performed by Ertec on privately owned wells and wells drilled as part of the Water Resources Program ranged from 4 to 19,000 ft^2/day (0.37 to 1766 m^2/day). Storativity ranged from 0.001 to 0.14.

o Based on lithologic logs, unconfined valley-fill aquifer conditions were indicated in all wells drilled and tested by Ertec except in Cave and Tule valleys. Cave and Tule valleys wells showed semiconfined to confined aquifer conditions.

o Drawdown of water levels in existing wells or alteration of spring discharge has not been detected during aquifer testing by Ertec.

o Valley-fill aquifer testing of an Air Force test well in Muleshoe Valley yielded 50 gpm (3 l/s) with 302 feet (92 m) of drawdown. Additional aquifer testing in the valley would be required to verify whether wells tapping the valley-fill aquifer would be capable of supplying the rates of withdrawal required for MX construction.

o Computer simulations of the valley-fill aquifer's response to projected MX pumping have been completed for Delamar, Dry Lake, Muleshoe, Pine, and Wah Wah valleys. Maximum simulated drawdowns at a distance of 1 mile (1.6 km) from MX production wells ranged from 0.8 feet (0.2 m) to 6 feet (2 m).

- The magnitude of these projected drawdowns is low and significant impacts to existing water users and the environment could be avoided or minimized through appropriate setback of Air Force wells from existing wells and environmentally sensitive areas, and through a comprehensive hydrologic monitoring program.

Table 3-2 provides a summary of valley-fill aquifer drilling and testing information.

3.3.2 Carbonate Aquifer Studies

Exploratory drilling and testing have been conducted in Steptoe, Coyote Spring, Dry Lake, and Coal valleys. The carbonate aquifer drilling and testing information is summarized in Table 3-3.

The preliminary results and conclusions of the studies are listed below:

- Potential well yields ranged from 3400 gpm (215 l/s) in Coyote Spring Valley to 95 gpm (6 l/s) in Coal Valley.

- Estimated transmissivities for the carbonate aquifer tests ranged from in excess of 40,000 ft^2/day (3717 m^2/day) in Coyote Spring Valley to a low of 200 ft^2/day (19 m^2/day) in Steptoe Valley.

- Specific capacities for the carbonate aquifer tests ranged from 283 gpm per foot (59 l/s per m) of drawdown in Coyote Spring Valley to 0.8 gpm per foot (0.2 l/s per m) of drawdown in Steptoe Valley.

- Carbonate aquifer drilling and testing results, evaluation of flow system behavior, and detailed analysis of structural features suggest that permeability development associated with faulting is a major factor controlling ground-water movement and, consequently, well development potential. The variation in well yields from the drilling and testing program is due to the different hydrostratigraphic sequences and the varying structural conditions encountered at each site.

VALLEY LEGAL DESCRIPTION	DRILLING RESULTS									
	DEPTH (FEET)		TEST WELL			OBSERVATION WELL				
			CASING DIAMETER (INCHES)	DRILLING DATES		DRILLED DEPTH (FEET)	PIEZOMETERS			D
	DRILLED	CASED		START	END		NO.	(INCHES)	DEPTH (FEET)	STA
Beryl O.B. (C-33-17)21dd	353	353	10	12/05/80	12/07/80	504	2	2	236& 332	12/0
Big Sand Springs 8N/53E-29da	620	573	10	03/23/81	04/07/81	649	2	2	493& 650	03/0
Cave 7N/63E-14ab	463	435	10	09/11/80	09/25/80	460	2	2	273& 422	08/2
Coal 1S/59E-34cb	1340	0-1123 1111-1315	10 6	12/13/80	02/19/81	1452	1	2	1452	12/1
Coyote Spring O.B. 12S/63E-29db	1221	860	10	12/15/80	01/28/81	714	2	2	560& 714	11/1
Delamar 6S/63E-12ad	1215	1195	10	02/29/80	03/12/80	1015	2	2	640& 981	02/1
Dry Lake 3S/64E-12ac	1010	990	10	01/26/80	02/12/80	1305	2	2	795& 1300	01/
Dugway #1 (C-12-10)31cc	402	400	10	07/28/80	08/01/80	------------NO OBSERVATION WELL				
Dugway #2 (C-11-10)19bb	----------NO TEST WELL DRILLED-------------					178	1	2.5	174	07/
Garden 2N/57E-22ba	1065	1010	10	09/11/80	10/24/80	1099	2	2	315& 1032	08/
Hamlin 8N/69E-35dc	480	475	10	08/18/80	08/21/80	522	1	2	435	08/

Legend for abbreviations:
DNA-Does not apply
O.P.-Observation well-pumping
NC-Not conclusive
O.R.-Observation well-recovery
NA-Not applicable
T.R.-Test well-recovery
o-Static water levels aft
Δ-Monitoring conducted 16
*-Preliminary Data

OBSERVATION WELL				DEPTH TO WATER (FEET)°		AQUIFER TEST RESULTS*				
ZOMETERS		DRILLING DATES				DIS-CHARGE (GPM)	TRANS-MISSIVITY (sq ft/day)	STORATIVITY		TESTING
(INCHES)	DEPTH (FEET)	START	END	TEST	OBSERVATION			INITIAL	DELAYED	START
2	236& 332	12/03/80	12/04/80	185	176& 193	600	13000 (T.R.)	DNA	DNA	01/08/81
2	493& 650	03/04/81	03/09/81	467	472& 469	435	7800 (T.R.)	DNA	DNA	05/12/81
2	273& 422	08/23/80	09/10/80	229	231& 231	223	2400 (O.P.)	$9.2x10^{-5}$	$1.3x10^{-2}$	10/13/80
2	1452	12/15/80	12/19/80	845	862	450	3700 (O.P.)	$4.0x10^{-4}$	$6.3x10^{-3}$	05/29/81
2	560& 714	11/13/80	11/22/80	N/A	547& 549	-----------------		NO AQUIFER TEST-----		-----------
2	640& 981	02/15/80	02/23/80	871	Dry& 867	85	1100 (O.P.)	NC	NC	05/03/80
2	795& 1300	01/03/80	01/24/80	395	383& 383	500	3400 (O.P.)	$5.3x10^{-4}$	$1.3x10^{-2}$	04/03/80
NO OBSERVATION WELL DRILLED--------				Dry	NA	-----------------		---NO AQUIFER TEST-----		-----------
2.5	174	07/28/80	07/29/80	NA	Dry	-----------------		---NO AQUIFER TEST-----		-----------
2	315& 1032	08/07/80	08/16/80	422	Dry& 431	517	12000 (O.P.)	$6.4x10^{-4}$	$2.5x10^{-3}$	11/05/80
2	435	08/06/80	08/07/80	158	176	110	2500 (O.P.)	$1.9x10^{-4}$	$1.0x10^{-2}$	09/09/80

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ER TEST RESULTS*				MONITORING△			
STORATIVITY		TESTING DATES		DEPTH TO WATER			COMMENTS
INITIAL	DELAYED	START	END	TEST WELL	DEEP PIEZOMETER	SHALLOW PIEZOMETER	
DNA	DNA	01/08/81	01/22/81	185	193	176	Water level taken on 8 January 1981
DNA	DNA	05/12/81	05/22/81	467	471	472	Water levels taken on 7 April 1981
$9.2x10^{-5}$	$1.3x10^{-2}$	10/13/80	10/25/80	228	230	229	
$4.0x10^{-4}$	$6.3x10^{-3}$	05/29/81	06/08/81	--------NOT MONITORED------------			
---NO AQUIFER TEST------------------------				627	550	549	No aquifer test, test well dry upon completion in alluvium
NC	NC	05/03/80	05/13/80	NA	867	Dry@590	Test well not accessible for sounding
$5.3x10^{-4}$	$1.3x10^{-2}$	04/03/80	04/27/80	395	383	383	Transmissivity and storativity values averaged from values obtained for both shallow and deep piezometers
-------NO AQUIFER TEST------------------------				Dry@ 327 ft	NA	NA	No observation well drilled
-------NO AQUIFER TEST------------------------				NA	Dry@174	NA	No test well drilled
$6.4x10^{-4}$	$2.5x10^{-3}$	11/05/80	12/12/80	421	430	Dry	
$1.9x10^{-4}$	$1.0x10^{-2}$	09/09/80	09/14/80	156	174	NA	

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VALLEY LEGAL DESCRIPTION	DRILLING RESULTS								
	DEPTH (FEET)		TEST WELL			OBSERVATION			
			CASING DIAMETER (INCHES)	DRILLING DATES		DRILLED DEPTH (FEET)	PIEZOMETERS		
	DRILLED	CASED		START	END		NO.	(INCHES)	DEPTH (FEET)
Hot Creek #1 7N/51E-10ad	540	480	10-0' to 340 8-340 to 480	08/26/80	08/29/80	500	1	2.5	480
Hot Creek #2 6N/50E-27ac	505	505	10	08/27/80	08/28/80	455	1	2.5	455
Milford O.B. (C-31-13)5bb	600	374	10	11/14/80	11/17/80	342	2	2.5	138& 342
Muleshoe 4N/64E-7dc	1215	1170	10	07/27/81	07/29/81	1253	2	2	672& 1134
Pine (C-26-17)10aa	951	870	10	06/25/80	07/12/80	1157	1	2	882
Railroad #1 3N/52E-2da	484	461	10	08/01/80	08/03/80	495	1	2.5	495
Railroad #2 10N/58E-17bd	610	580	10	09/18/80	09/21/80	604	2	2.5	220& 600
Reveille 3N/50E-13ca	681	680	10	02/10/81	02/13/81	710	2	2	405& 703
Spring 9N/68E-30ab	700	699	10	08/03/80	08/07/80	700	2	2	247& 700
Tule #1 (C-20-14)6dd	624	620	10	07/08/80	07/10/80	620	1	2.5	620
Tule #2 (C-17-15)17ca	430	400	10	07/09/80	07/16/80	310	1	2.5	296
Wah Wah (C-26-14)25ab	---------NO TEST WELL DRILLED---------					1250	1	2	1114

Legend for abbreviations:
DNA-Does not apply
O.P.-Observation well-pumping
NC-Not conclusive
O.R.-Observation well-recovery
NA-Not applicable
T.R.-Test well-recov
o-Static water level
Δ-Monitoring conduct
*-Preliminary Data

RVATION WELL			AQUIFER TEST RESULTS*							
ERS	DRILLING DATES		DEPTH TO WATER (FEET)°		DIS-CHARGE (GPM)	TRANS-MISSIVITY (sq ft/day)	STORATIVITY		TESTING DATES	
DEPTH (FEET)	START	END	TEST	OBSERVATION			INITIAL	DELAYED	START	EN
480	09/02/80	09/03/80	237	256	235	19000 (O.P.)	$1.3x10^{-3}$	$2.0x10^{-2}$	09/26/80	10/09/
455	09/06/80	09/07/80	292	304	375	1600 (O.P.)	$1.4x10^{-4}$	$4.1x10^{-3}$	09/24/80	10/03/
138& 342	11/22/80	11/22/80	31	31& Dry	350	3400 (O.P.)	$4.5x10^{-4}$	$8.0x10^{-2}$	12/08/80	12/17/
672& 1134	06/27/81	07/02/81	268	270& 264	50	30 (O.P.)	$1.0x10^{-4}$	$6.2x10^{-4}$	08/24/81	09/05/
882	06/08/80	06/16/80	443	434	75	330 (O.P.)	$2.2x10^{-4}$	$1.6x10^{-3}$	07/20/80	08/10/
495	08/14/80	08/15/80	233	235	735	11000 (O.P.)	$1.5x10^{-4}$	$6.0x10^{-2}$	08/12/80	09/29/
220& 600	09/20/80	09/21/80	281	Dry& 280	705	7900 (O.P.)	$3.3x10^{-4}$	$1.1x10^{-3}$	10/19/80	11/30
405& 703	02/04/81	02/06/81	316	321& 321	550	5000 (O.P.)	$1.2x10^{-4}$	$1.2x10^{-2}$	04/01/81	04/11
247& 700	08/09/80	08/11/80	230	Dry& 219	600	NC	NC	NC	09/09/80	09/22
620	07/21/80	07/21/80	84	89	50	NC	DNA	DNA	07/28/80	08/1
296	07/21/80	07/22/80	47	53	255	NC	DNA	DNA	08/01/80	08/1
1114	07/07/80	07/30/80	NA	Dry	----------------	----------------	NO AQUIFER TEST	----------------	----------------	----------------

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TEST RESULTS*				MONITORING△			COMMENTS
STORATIVITY		TESTING DATES		DEPTH TO WATER			
INITIAL	DELAYED	START	END	TEST WELL	DEEP PIEZOMETER	SHALLOW PIEZOMETER	
$1.3x10^{-3}$	$2.0x10^{-2}$	09/26/80	10/09/80	238	255	NA	
$1.4x10^{-4}$	$4.1x10^{-3}$	09/24/80	10/03/80	291	301	NA	
$4.5x10^{-4}$	$8.0x10^{-2}$	12/08/80	12/17/80	28	Dry	28	
$1.0x10^{-4}$	$6.2x10^{-4}$	08/24/81	09/05/81	-------NOT MONITORED-------			
$2.2x10^{-4}$	$1.6x10^{-3}$	07/20/80	08/10/80	437	434	NA	
$1.5x10^{-4}$	$6.0x10^{-2}$	08/12/80	09/29/80	230	233	NA	
$3.3x10^{-4}$	$1.1x10^{-3}$	10/19/80	11/30/80	279	278	NA	
$1.2x10^{-4}$	$1.2x10^{-2}$	04/01/81	04/11/81	316	321	321	Water levels monitored on 1 April 1981
NC	NC	09/09/80	09/22/80	229	219	Dry@165	
DNA	DNA	07/28/80	08/15/80	86	89	NA	
DNA	DNA	08/01/80	08/15/80	47	53	NA	
--- NO AQUIFER TEST -----------------------				NA	236	NA	Following drilling the well was dry

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VALLEY LEGAL DESCRIPTION	DRILLING RESULTS									
	DEPTH (FEET)		TEST WELL			OBSERVATION WE				
			CASING DIAMETER (INCHES)	DRILLING DATES		DRILLED DEPTH (FEET)	PIEZOMETERS			
	DRILLED	CASED		START	END		NO.	(INCHES)	DEPTH (FEET)	
Wah Wah (C-27-14) 28dd	1399	1350	10	10/23/80	12/10/80	1399	1	2	987	07
Whirlwind (C-15-12) 19ad	1033	1025	10	10/20/80	11/10/80	1220	1	2	1191	0
White River 8N/61E-27dc	----------NO TEST WELL DRILLED------------					1300	2	2	200& 400	11

Legend for abbreviations:

DNA-Does not apply
O.P.-Observation well-pumping
NC-Not conclusive
O.R.-Observation well-recovery
NA-Not applicable

T.R.-Test well-recover
o-Static water levels
Δ-Monitoring conducte
*-Preliminary Data

				AQUIFER TEST RESULTS*							
OBSERVATION WELL				DEPTH TO WATER (FEET)°		DIS-CHARGE (GPM)	TRANS-MISSIVITY (sq ft/day)	STORATIVITY		TESTING D	
OMETERS		DRILLING DATES									
CHES)	DEPTH (FEET)	START	END	TEST	OBSERVATION			INITIAL	DELAYED	START	
	987	07/27/80	08/27/80	570	569	375	12000 (O.P.)	$1.8x10^{-3}$	$1.4x10^{-1}$	04/14/81	04
	1191	09/15/80	10/13/80	798	794	7	4.0 (T.R.)	DNA	DNA	12/08/80	12
	200& 400	11/20/79	12/19/79	NA	42	----------	--------NO AQUIFER TEST------	----------	----------	----------	----------

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...FER TEST RESULTS*						MONITORING∆			COMMENTS
	STORATIVITY		TESTING DATES		DEPTH TO WATER				
	INITIAL	DELAYED	START	END	TEST WELL	DEEP PIEZOMETER	SHALLOW PIEZOMETER		
)	1.8×10^{-3}	1.4×10^{-1}	04/14/81	04/24/81	570	564	NA		
	DNA	DNA	12/08/80	12/18/80	795	797	NA		
-----NO AQUIFER TEST-----------------------					NA	40	40		No test well drilled

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VALLEY LEGAL DESCRIPTION	DRILLING RESULTS								
	DEPTH (FEET)		TEST WELL			OBSERVATION			
			CASING DIAMETER (INCHES)	DRILLING DATES		DRILLED DEPTH (FEET)	PIEZOMETERS		
	DRILLED	CASED		START	END		NO.	(INCHES)	DEPTH (FEET)
Coal/Garden 3N/59E-10bd	1837	0-118	10	08/17/80	12/08/80	---------NO OBSERVATION WEL			
Coyote Spring O.B. 13S/63E-23ddd	669	0-50.5	10	11/20/80	12/10/80	---------NO OBSERVATION WEL			
Coyote Spring O.B. 13S/63E-23dd	628	0-126	20	04/14/81	05/05/81	---------NO OBSERVATION WEL			
Coyote Spring O.B. 13S/64E-35dd	937	0-87 0-325	12 3/4 8 5/8	05/21/81	06/03/81	---------NO OBSERVATION WEL			
Dry Lake 3N/63E-27ca	2395	0-347 0-775	10 8	10/23/80	11/21/80	---------NO OBSERVATION WE			
Steptoe 12N/63E-12ba	2447	0-50 0-958	8 6	08/28/80	10/13/80	---------NO OBSERVATION WE			

Legend for abbreviations: DNA-Does not apply
NA-Not applicable
o-Static water levels after well development
Δ-Monitoring conducted 16-19 February 1981
*-Preliminary Data

RVATION WELL			AQUIFER TEST RESULTS*							
RS	DRILLING DATES		DEPTH TO WATER (FEET)°		DIS-CHARGE (GPM)	TRANS-MISSIVITY (sq ft/day)	STORATIVITY		TESTING DATES	
DEPTH (FEET)	START	END	TEST	OBSERVATION			INITIAL	DELAYED	START	END
TION WELL DRILLED---------			803	NA	95	400	DNA	DNA	01/13/81	01/16/
TION WELL DRILLED---------			353	NA	540	40,000	DNA	DNA	12/18/80	12/23/
TION WELL DRILLED---------			350	NA	3400	T value pending final analysis	DNA	DNA	07/10/81	09/28/
TION WELL DRILLED---------			458	NA	----------------AQUIFER TESTING PENDING----------------					
TION WELL DRILLED---------			853	NA	106	13,400	DNA	DNA	12/07/80	12/12/
TION WELL DRILLED---------			427	NA	100	200	DNA	DNA	01/18/81	01/21/

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...ER TEST RESULTS*				MONITORING Δ			
STORATIVITY		TESTING DATES		DEPTH TO WATER			COMMENTS
INITIAL	DELAYED	START	END	TEST WELL	DEEP PIEZOMETER	SHALLOW PIEZOMETER	
DNA	DNA	01/13/81	01/16/81	804	NA	NA	(CV-DT-1)
DNA	DNA	12/18/80	12/23/80	354	NA	NA	(CE-DT-4)
DNA	DNA	07/10/81	09/28/81	Not Moni-tored	NA	NA	(CE-DT-5)
--AQUIFER TESTING PENDING--------------------				Not Moni-tored	NA	NA	(CE-DT-6) Used as observation well for CE-DT-5 testing.
DNA	DNA	12/07/80	12/12/80	851	NA	NA	(DL-DT-3)
DNA	DNA	01/18/81	01/21/81	424	NA	NA	Well cased to 958 feet below land surface. Aquifer test performed through perforated casing (SV-DT-2).

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TABLE 3-3

- The carbonate aquifer units with the greatest potential for supplying water for MX needs are 1) the Pole Canyon Limestone of Cambrian age, 2) undifferentiated limestones and dolomites of Cambrian to Ordovician age, and 3) the Ely Springs, Laketown, Sevy and Simonson dolomites, and the Guilmette Formation of Ordovician to Devonian age.

- A major aquitard controlling regional ground-water movement is the Chainman Shale and Scotty Wash Quartzite of Mississippian age.

- Deep-seated basin and range faults, which displace carbonate rocks, serve to establish ground-water conduits which are capable of transmitting a large amount of recharge water to the various carbonate aquifers and also provide avenues for upward and lateral transport of deeply circulated ground water.

- The siting area valleys that have an estimated high potential for carbonate aquifer development are Butte, Cave, Coal, Coyote Spring (OB), Dry Lake, Garden, Hamlin, Kobeh, Muleshoe, Pahroc, Railroad, Spring, and White River.

- Existing quality data from regional springs and analyses of spring and well samples collected indicate that water within the carbonate aquifers generally meet standards for construction and domestic water use. All water is basically of the calcium-magnesium-bicarbonate type. Significant amounts of sulfate and chloride are present near the terminus of some flow systems where mixing with noncarbonate water may be occurring. The averages for total dissolved solids in individual valleys ranged from 300 to 650 mg/l.

3.3.3 Operational Base Studies

Operational base studies were conducted for the potential OB sites in Coyote Spring Valley, Nevada, and Escalante Desert, Utah.

The results and conclusions of the OB studies are summarized below:

- Due to the inadequate supply of surface water available in Coyote Spring Valley, any surface water for the OB would have to be leased or purchased and piped from the Muddy River Springs area, southwest of the valley, or from the Overton Arm of Lake Mead (Colorado River).

- The valley-fill deposits in Coyote Spring Valley will provide only limited development of ground water. The valley-fill aquifer is not considered to be an adequate source of water for OB construction and operation. Tests conducted by Ertec in the central part of the valley indicate low hydraulic conductivity and, consequently, low anticipated well yields for these deposits.

- A test well in southern Coyote Spring Valley that penetrated fractured carbonate rock was pumped by Ertec for 30 days at a rate of 3400 gpm (215 l/s) with approximately 12 feet (4 m) of drawdown. These results suggest a potential yield of water from the carbonate system more than adequate to meet current OB water-supply requirements for construction and operational use.

- Significant short-term impacts to downflow surface and ground-water users in the Muddy River Springs area due to MX ground-water withdrawals from the carbonate aquifer in Coyote Spring Valley are not expected based on the results of carbonate aquifer tests.

- All but four of the sites with available water chemistry analyses in Coyote Spring Valley and the adjacent Muddy River Springs area meet federal and state drinking water standards. Three water samples that did not meet standards are from wells located in an area of high domestic and agricultural use in the Moapa area. Water from the carbonate test wells in Coyote Spring Valley does not meet federal or state drinking water standards for fluoride. All water samples analyzed meet the criteria established by the Portland Cement Association for the mixing of cement.

- Existing use of ground water in Escalante Desert, Utah, (Milford and Beryl OB sites) exceeds the estimated annual rate of replenishment, and the Utah State Engineer has closed the basin to additional ground-water appropriations.

- Lease or purchase of existing surface or ground-water rights will be necessary to supply water for OB construction and operation in Escalante Desert.

- The valley-fill aquifer at both of the proposed OB locations in the Milford and Beryl districts is capable of delivering water in sufficient quantities and of acceptable quality to meet MX Operational Base requirements. Existing ground-water rights could be leased or purchased, the points of diversion transferred to a location at or near the OB, and a new well or wells drilled for MX water supply.

- Well yield during valley-fill aquifer testing at the Milford OB site was 350 gpm (22 l/s). A transmissivity of 3400 ft^2/day (316 m^2/day) and a storativity of 0.08 were calculated from test results.

- Well yield during valley-fill aquifer testing at the Beryl OB site was 600 gpm (38 l/s). A transmissivity of 13,000 ft^2/day (1208 m^2/day) was calculated from test results. No storativity has been determined.

- Preliminary numerical analysis of a well field at each candidate OB site in the valley was performed using a computer simulation of six wells withdrawing ground-water at a total rate of 2900 acre-ft/yr (3.6 hm^3/yr) for 30 years. For a secondary OB site in Beryl, a water-level drawdown of 9 feet (3 m) at 1 mile (1.6 km) and 2 feet (0.6 m) at 6 miles (10 km) from the well field was obtained after 30 years. In Milford, a drawdown of 11 feet (3 m) at 1 mile (1.6 km) and 4 feet (1 m) at 6 miles (10 km) from the well field was obtained after 30 years.

3.3.4 Water Management Planning

Preliminary water management plans were developed for the following valleys:

Cave	Escalante Desert (OB)	Pahroc
Coal	Garden	Pine
Coyote Spring (OB)	Hamlin	Spring
Delamar	Lake	Wah Wah
Dry Lake	Muleshoe	

The four basic water-supply sources considered are 1) the appropriation of ground water and the construction of wells in the valley-fill aquifer, 2) the appropriation of ground water and the construction of wells in the regional carbonate aquifer, 3) the lease or purchase of existing surface- or ground-water rights, and 4) the importation of water from "water rich" valleys or sources, such as Railroad, Spring, and Snake valleys and the Colorado River. These water-supply sources were evaluated for each of the 14 study valleys based on legal and physical water availability, potential impacts of withdrawal, cost, timeliness to develop, and water quality. The results of this evaluation along with the results of the water-supply

system evaluation and recommended additional investigations are summarized in Table 3-4.

Primary and secondary suitable areas, and excluded areas for MX valley-fill aquifer water-supply well development, have been identified for each of the 14 study valleys based on cultural, hydrogeologic, environmental, and legal considerations. All of the 14 study valleys have suitable drilling areas for valley-fill aquifer water-supply wells with the exception of Coyote Spring Valley. The results of Ertec testing of a test well indicate that the valley-fill aquifer is not a viable water-supply source for OB construction and operation in that valley.

The principal elements of a hydrologic monitoring program, which is an important factor in water management, include monitoring of ground-water levels, spring discharges, and surface- and ground-water chemistry. Streamflow should also be monitored in certain areas. Where possible, monitoring sites or stations should be located to detect hydrologic changes prior to impact at existing wells or springs.

If significant or unacceptable impacts of existing water sources (wells, springs, or streams) are projected or develop there are several mitigation options available:

- Reduction of the rate of water withdrawal at the Air Force point of diversion causing impact;
- Cessation of water withdrawal at the Air Force point of diversion causing impact;
- Delivery of water to the impacted point of diversion to compensate for temporarily reduced production capacity or water quality.

VALLEY	PREFERRED WATER-SUPPLY SYSTEM AND SOURCE OF MX WATER								NUMBER OF RECOMMENDED ADDITIONAL DRILLING/TESTING SITES PRIOR TO WATER-SUPPLY SYSTEM DEVELOPMENT
	EXISTING AF WELL	VALLEY-FILL DEVELOPMENT	CARBONATE DEVELOPMENT	LEASE–PURCHASE	IMPORTATION	EARLY STORAGE	AF POD *	AMMEND AF POD *	
CAVE	■	■					■	■	1
COAL	■	■					■	■	2
COYOTE SPRING	■		■				■	■	1
DELAMAR	■	■				■	■	■	2
DRY LAKE	■	■					■	■	2
ESCALANTE	■	■		■					0
GARDEN	■	■					■	■	1
HAMLIN	■	■					■	■	2
LAKE		■		■					1
MULESHOE	■	■					■	■	1
PAHROC		■					■		1
PINE	■	■					■	■	1
SPRING	■	■					■	■	1
WAH WAH	■	■					■	■	2

* POD = PENDING AIR FORCE GROUND-WATER APPROPRIATION APPLICATION POINT OF DIVERSION

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SUMMARY OF WATER MANAGEMENT PLANNING RESULTS

6 NOV 81 TABLE 3-4

3.4 WATER APPROPRIATIONS

Ertec filed applications for appropriation of ground water in 29 deployment valleys within the Nevada-Utah siting area in FY 80, and in six deployment valleys and three potential OB sites in FY 81. Table 3-5 lists the valleys for which water appropriation applications have been filed, the quantity of ground water requested, and other details of the filing.

The total quantity of ground water by valley, listed in Table 3-5, is based on the number of MX clusters sited in a valley as determined from Ertec MX shelter layouts and on COE construction water-use estimates (17 March 1981) for the Main and Alternative OB site valleys. The table also lists the number of points of diversion for each valley. The total annual quantity of ground water requested in Snake Valley is higher than other deployment valleys due to Nevada and Utah limitations on the transfer of water rights from one state to the other even though it is within the same hydrologic basin.

The total quantity of ground water requested annually for construction in each deployment valley includes water for a construction plant and camp in each valley except Delamar Valley.

Applications for appropriation of ground water at the potential OB sites in Coyote Spring Valley, Steptoe Valley (Ely), and Sevier Desert (Delta) were filed in early and mid FY 81. No applications were filed for the Milford and Beryl OB sites because the Utah State Engineer will not allow additional

VALLEY	TOTAL QUANTITY OF GROUND WATER REQUESTED (ACRE - FT/YR)	NUMBER OF POINTS OF DIVERSION	DATE OF FILING
DRY LAKE	3810	1	1-30-80
DELAMAR	1585	1	1-30-80
WHITE RIVER	3810	1	1-30-80
SNAKE	5687	5	10-25-79 & 7-15-80
REVEILLE	2770	5	7-11-80
HOT CREEK	3115	5	7-11-80
LITTLE SMOKY	2076	3	7-11-80
ANTELOPE	3805	5	7-11-80
RAILROAD	4148	4	7-11-80
GARDEN	3456	8	7-11-80
COAL	3456	9	7-11-80
PAHROC	1388	4	7-11-80
MULESHOE	1731	3	7-11-80
CAVE	2076	6	7-11-80
SPRING	2425	5	7-11-80
HAMLIN	3464	5	7-11-80
PINE	2421	5	7-11-80
TULE	4146	8	7-11-80
FISH SPRINGS FLAT	2537	8	7-11-80
WAH WAH	3801	7	7-11-80
WHIRLWIND	3685	8	7-11-80
DUGWAY	3111	5	7-11-80
SEVIER	2076	3	7-11-80
STONE CABIN	4152	8	7-15-80
RALSTON	4152	8	7-15-80
BIG SAND SPRINGS	2076	4	7-15-80
PENOYER	2422	2	7-15-80
LAKE	3805	5	7-15-80
BIG SMOKY	4146	3	7-15-80
BUTTE	2464	4	11-18-80 & 6-8-81
JAKES	1758	3	11-18-80
KOBEH	3530	5	11-18-80
NEWARK	1404	2	11-18-80
MONITOR	2112	3	11-18-80
LONG	1404	2	5-25-81
OB SITES			
COYOTE SPRING	19370 *	2	5-25-81 & 7-24-81
STEPTOE**	9685	1	11-18-80
ESCALANTE DESERT***	–	–	–

* Two applications presently on file for 9685 acre-ft./yr. each. Only one will be acted upon.

** The quantity requested for this valley was based on the assumption that it was a potential OB site. At this time Steptoe Valley is being considered for missile deployment only.

*** No applications filed.

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GROUND–WATER APPROPRIATION APPLICATIONS

6 NOV 81

TABLE 3-6

appropriation of ground water in the Milford and Beryl portions of the Escalante Desert.

In Coyote Spring Valley, there are two points of diversion for which 9685 acre-ft/yr (22.1 hm^3/yr) of ground water have been requested, one valley-fill aquifer site and one carbonate aquifer site. Testing by Ertec at the valley-fill aquifer site, subsequent to the filing (November 1980) of the application to appropriate ground water, indicated that the valley-fill aquifer would be incapable of supplying the quantity of water required during peak year MX use. Another application for 9685 acre-ft/yr (22.1 hm^3/yr) was filed (July 1981) for the productive carbonate aquifer site which had been drilled at a later date (April 1981) and proven capable of supplying most of the estimated peak year construction water requirement of 9685 acre-ft/yr (22.1 hm^3/yr).

Preparation for MX water appropriation application hearings, which were expected to begin by the end of 1981, focused on the 12 deployment and two OB site valleys in which construction was scheduled in 1982 and 1983 according to the COE. These valleys are listed in Section 3.3.4, Water Management Planning. A detailed example of the intended hearing presentation in support of the Air Force applications for ground water in Dry Lake Valley was developed by Ertec. This was intended to serve as a model for presentations on other MX valleys. A copy of the presentation was submitted to Air Force for review at the end of FY 81.

4.0 AGGREGATE RESOURCES PROGRAM

4.1 BACKGROUND

The MX aggregate program began in 1977 with the investigation of Department of Defense (DoD) and BLM lands in California, Nevada, Arizona, New Mexico, and Texas. Refinement of the potential MX siting area in FY 79 added portions of Utah and Nevada that were not studied in the initial Aggregate Resource Evaluation Investigation (AREI) for portions of Nevada and California. This additional area, defined as the Utah Aggregate Resources Study Area (UARSA) was evaluated in a second general aggregate resources investigation that was submitted on 3 March 1980.

Valley-specific Aggregate Resources Studies (VSARS), initiated in FY 79, were more detailed and utilize to a greater extent the geologic and engineering data obtained from Verification studies. The Detailed Aggregate Resource Studies (DARS), begun in FY 81, more closely examine and refine potential basin-fill and crushed rock aggregate sources identified during previous studies.

4.2 OBJECTIVES AND SCOPE

4.2.1 Valley-Specific Aggregate Resources Study

The main objectives of the valley-specific studies were to determine the suitability of basin-fill deposits and ledge rock in concrete mixes and road construction.

The scope of work for a valley was as follows:

- o Identify and sample potential aggregate sources in the valley and adjacent mountains;
- o Perform laboratory tests including gradation, L.A. abrasion, $MgSO_4$ and $NaSO_4$ soundness, alkali reactivity, and specific gravity and absorption;
- o Compile and evaluate test data; and
- o Prepare valley reports with the results of the study and conclusions.

4.2.2 Detailed Aggregate Resources Study

Detailed Aggregate Resources Studies (DARS), initiated in 1980, further defined potential crushed rock and coarse and fine basin-fill aggregate sources identified during previous aggregate studies. The objectives of the two evaluations comprising the DARS were as follows:

Road-Base Aggregates Evaluation

- o Refine the location of potential basin-fill and rock sources (initially identified in VSARS) for road-base aggregates; and
- o Provide additional laboratory test data on the general quality of basin-fill aggregates for use as road-base material.

Concrete Aggregates Evaluation

- o Refine the areal extent of the most acceptable VSARS basin-fill and rock concrete aggregate sources; and
- o Provide additional laboratory testing information on the quality and concrete-making properties of potential coarse and fine basin-fill and crushed-rock aggregates.

The scope of this evaluation included the following:

a. Compilation and analysis of appropriate existing data on the quality and quantity of potential road-base and concrete aggregates.

b. Selection and backhoe excavation of staked and permitted basin-fill locations; sampling when gravel percentage exceeded 30 percent, or when suitable fine aggregates for concrete mixes were present. Selection and sampling of acceptable crushed-rock sources of coarse aggregates for concrete mixes.

c. Laboratory tests to supplement available existing data for the determination of the suitability of specific basin-fill and rock units as sources of road-base or concrete aggregates.

Road-Base Aggregate Tests

- Gradation Analysis
- L.A. Abrasion
- 5-Cycle $MgSO_4$ Soundness

Concrete Aggregate Tests

- Gradation Analysis
- L.A. Abrasion
- 5-Cycle $MgSO_4$ Soundness
- 5-Cycle $NaSO_4$ Soundness
- Alkali Reactivity
  - Petrographics
  - Mortar-bar Method
  - Carbonate Rock Test
- Trial Concrete Mixes
  - Concrete Mix Design
  - Trial Batches
  - Cylinder Breaks

d. Development and application of road-base and concrete materials classification systems that textually and graphically depict the locations of the most suitable aggregate sources in the study area.

4.3 STATUS OF PROGRAMS

The progress of the Valley-Specific Aggregate Resources Study is summarized in Table 4-1 and Figure 4-1. Reports for six valleys field investigated in FY 80 were finalized and submitted in FY 81. Cave and Steptoe valleys were evaluated in FY 81.

Detailed aggregate studies field work was completed for Dry Lake, Delamar, Pahroc, Muleshoe, Pine, and Wah Wah valleys in

VALLEY	FIELD WORK COMPLETED	REPORT DATE
WHIRLWIND	SEPTEMBER 1979	JUNE 1980
HAMLIN	SEPTEMBER 1979	JUNE 1980
SNAKE	SEPTEMBER 1979	JUNE 1980
WHITE RIVER	OCTOBER 1979	JUNE 1980
DRY LAKE	NOVEMBER 1979	JUNE 1980
MULESHOE	NOVEMBER 1979	JUNE 1980
DELAMAR	NOVEMBER 1979	JUNE 1980
PAHROC	NOVEMBER 1979	JUNE 1980
PINE	AUGUST 1980	FEBRUARY 1981
WAH WAH	AUGUST 1980	FEBRUARY 1981
TULE	AUGUST 1980	JULY 1981
LAKE	SEPTEMBER 1980	FEBRUARY 1981
GARDEN	SEPTEMBER 1980	JULY 1981
COAL	SEPTEMBER 1980	JULY 1981
CAVE	OCTOBER 1980	SEPTEMBER 1981
STEPTOE	OCTOBER 1980	SEPTEMBER 1981

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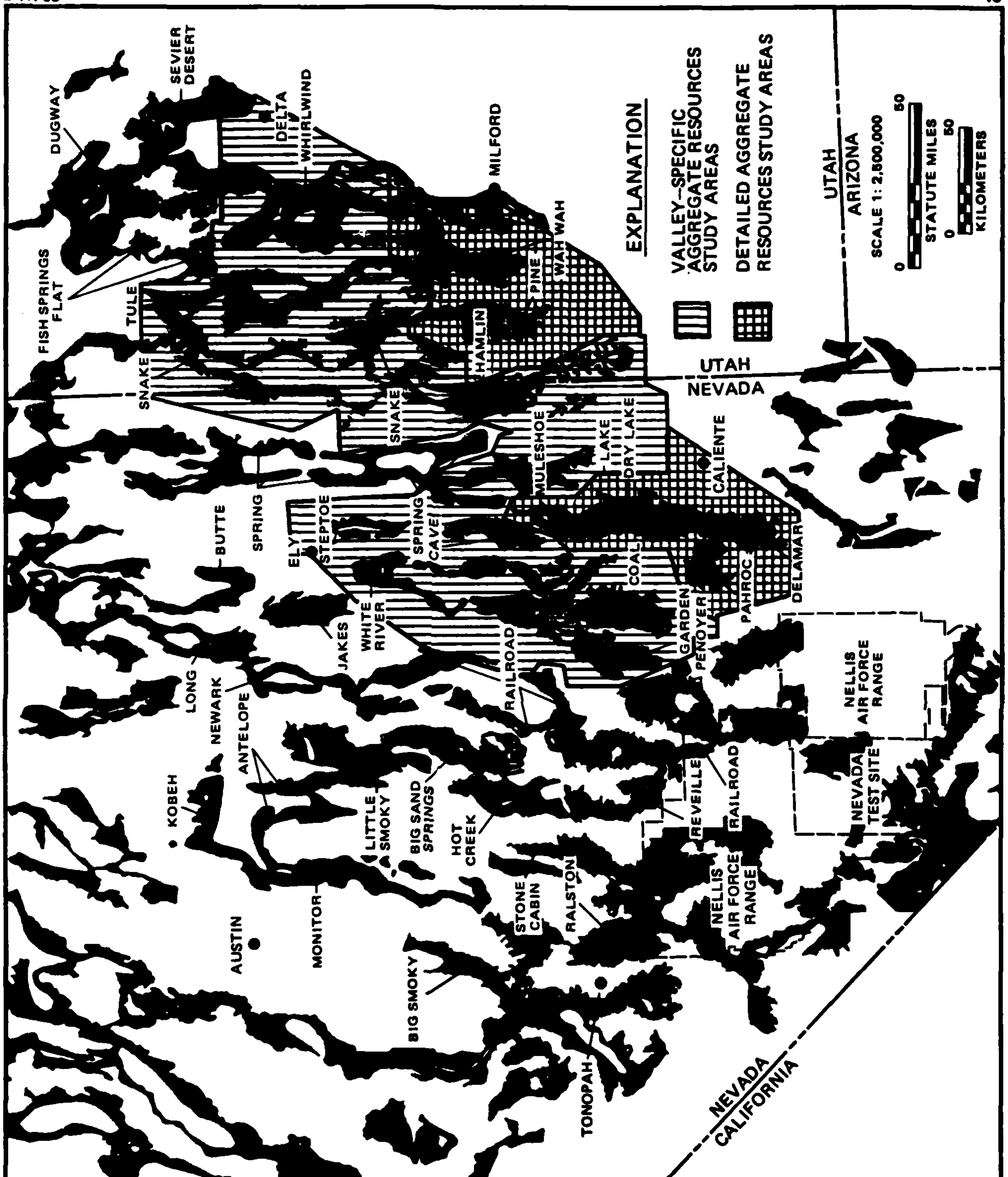
SUMMARY OF AGGREGATE RESOURCES STUDIES

6 NOV 81 TABLE 4-1



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AGGREGATE RESOURCES STUDIES
NEVADA–UTAH

6 NOV 81

FIGURE 4-1

October and November 1980 (Figure 4-1). Final reports were submitted in May and June 1981.

4.4 CONCLUSIONS

From the valley studies, it is concluded that all investigated areas appear to have adequate gravel, sand, and crushed-rock sources, although quality and quantity are variable. Valleys influenced by Pleistocene Lake Bonneville (Whirlwind, Wah Wah, Snake, and Tule) have abundant, well-defined, high quality gravel reserves deposited in lacustrine shoreline features. Valleys where alluvial processes are dominant possess somewhat lower quality and less distinct gravel reserves deposited in alluvial fans.

High quality sources of sand are of limited distribution. The only major sources of suitable high quality sand are located in lacustrine or alluvial deposits derived directly from granitic rock sources (e.g., Deep Creek Range bordering Snake Valley).

Sources of high quality crushed rock are available for all valleys. Paleozoic and Precambrian carbonate and quartzitic rock units are extensive and widely distributed in numerous Utah and Nevada formations. In addition, individual units within widespread undifferentiated Tertiary volcanics will also supply acceptable crushed-rock sources.

Although most rock will supply acceptable coarse aggregates, limited sources are delineated in this study. Sufficient quantities of basin-fill aggregates within the valley will probably make processing of crushed-rock aggregates unnecessary.

Results of the Detailed Aggregate Resources Study indicate that there are sufficient quantities of acceptable coarse and fine, road-base and concrete aggregates available for the construction of the MX missile system in the study areas. Because of less stringent physical and chemical requirements, road-base aggregate sources are larger and more widespread than concrete aggregate sources.

Concrete made from aggregates excavated from sources within the valley areas generally met or exceeded the design requirement of 28-day compressive strengths of 6500 psi. Mixes containing only basin-fill gravel and sand aggregates ranged in compressive strength from 4505 to 8160 psi. Mixes which contained crushed rock and local sand aggregates generally had higher 28-day compressive strengths, ranging from 3830 to 8790 psi.

5.0 SITING STUDIES

5.1 BACKGROUND

Ertec has performed siting studies for deployment of the MX missile in the Nevada-Utah siting area for a period of three years and has carried out limited studies in New Mexico in FY 81. In FY 79 and FY 80, the siting program was limited to methodology studies and experimentation with various basing modes. These studies continued as a minor program at the start of FY 81, and it was not until the second half of FY 81 that the siting program was expanded into a major program to meet the requirements of the tiering process and the schedules of the initial Land Acquisition Package.

The siting programs in FY 79 and FY 80 are discussed in previous executive summary reports and are summarized as follows:

- In FY 79, the following activities took place:
  - Initial shelter siting in Dry Lake Valley, Nevada; and
  - Initial routing studies for the DTN.

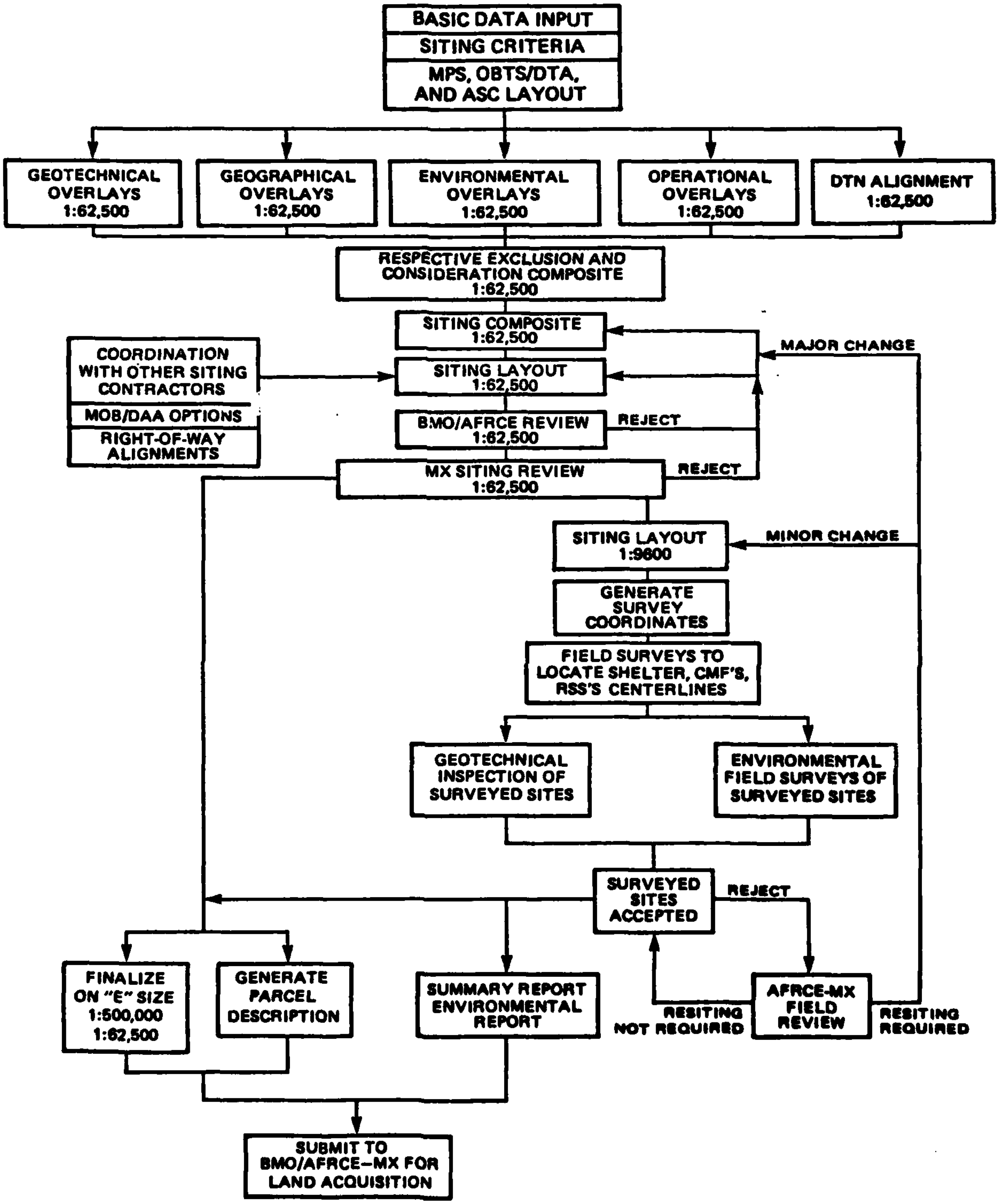
- In FY 80, the siting studies consisted of:
  - Conceptual cluster layouts of all valleys in the Nevada/Utah Deployment Area at a scale of 1:62,500;
  - Conceptual Designated Transportation Network (DTN) routes from the various Main Operating Base (MOB) sites in Nevada and Utah;
  - Initial siting studies for the four Area Support Centers (ASCs);
  - Completion of shelter layouts at a scale of 1:9600 for Dry Lake Valley and the starting of similar layouts for Pine and Wah Wah Valley; and
  - Initial siting studies for the Operational Base (OB) and Operational Base Test Site (OBTS).

5.2 OBJECTIVES AND METHODOLOGY

The primary objective of the siting program in FY 81 has been to complete conceptual layouts for shelters, conceptual routing for the DTN, and determine possible locations for the OBTS and ASCs. The results of these studies were depicted on topographic base maps at a scale of 1:62,500 as the first step in the planning and design process. When completed, these conceptual layouts could be used for follow-on environmental assessments, field surveys, as portions of bid documents for final layout studies and design, and for incorporation in a Land Acquisition Package.

To complete the objectives required a rather complex siting process which is depicted in the flow charts in Figures 5-1 and 5-2. The starting point for the process was suitable area boundaries as determined from the Verification program. A series of overlays were prepared to identify geotechnical, geographical, and environmental factors which needed to be considered. After completion of the layouts, they were reviewed by BMO/AFRCE. Following this review, the layouts were sent to MX state coordination offices for review by various state agencies. Based on their comments, the layouts were modified and final drawings were prepared for the Land Acquisition Package.

The right portion of both flow charts shows the process that was used in those valleys identified as possible Initial Operational Capability (IOC) valleys. In these valleys, shelter sites were located and field surveys were carried out.



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METHODOLOGY FLOW CHART
FACILITY LAYOUT
SITE-SELECTION PROCESS

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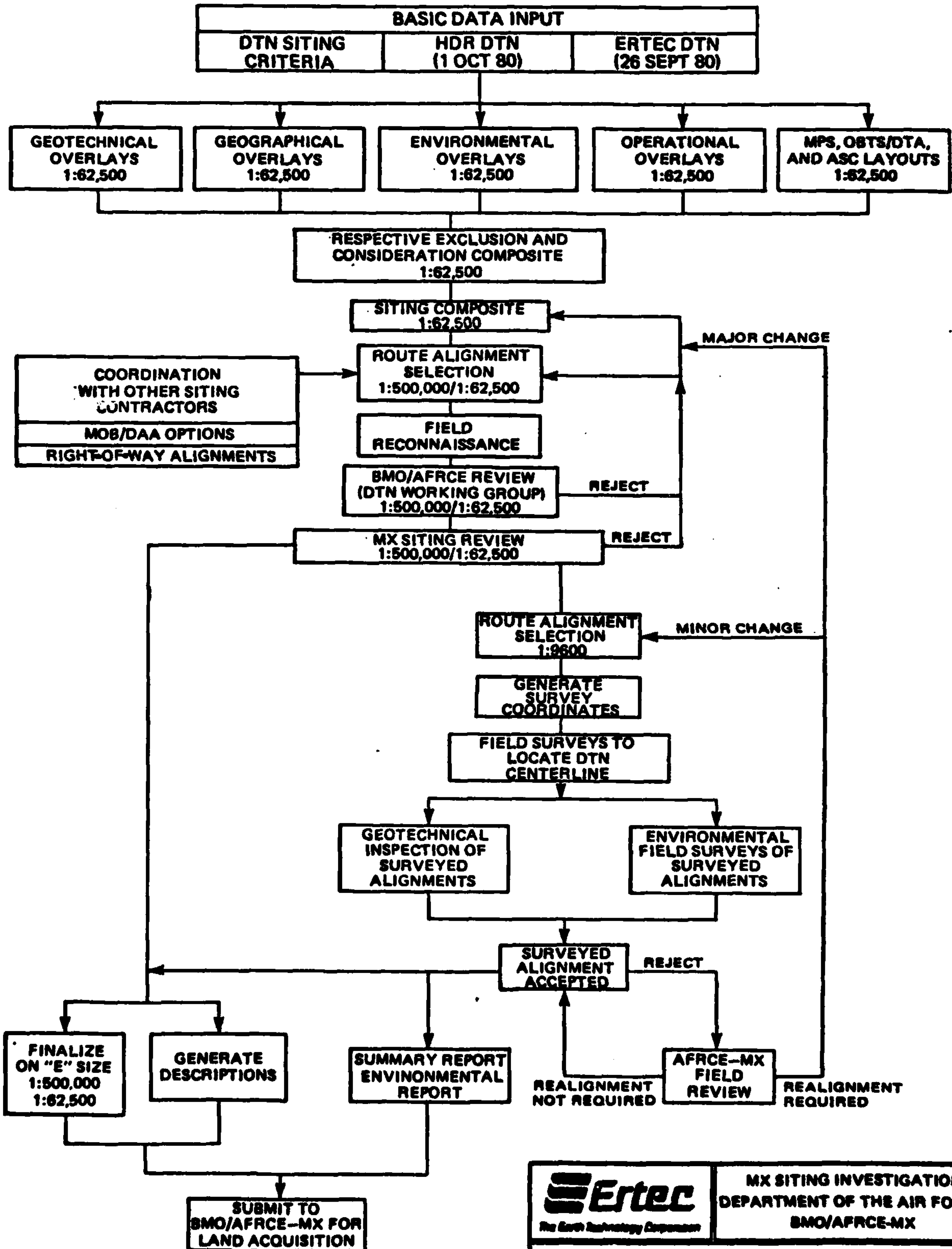
FIGURE 5-1



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METHODOLOGY FLOW CHART
DESIGNATED TRANSPORTATION NETWORK
ALIGNMENT–SELECTION PROCESS

6 NOV 81 FIGURE 5-2

5.3 SITING CRITERIA AND REQUIREMENTS

The general geometric and spatial shelter layout requirements for the Multiple Protective Structure (MPS) system are as follows:

- o 5200-foot (1586-m) spacing ± 200 feet (61 m);
- o 2/3-filled hexagonal pattern;
- o Relative angle formed by the longitudinal centerline of neighboring shelters: nominal 60°, minimum 55°;
- o Twenty-three shelters with 11 or 12 backfills per cluster; and
- o Maximum of three near neighbors per shelter.

For ASCs the general siting requirements are:

- o Each ASC is to provide security coverage for a circular area with a radius of 65 statute miles;
- o Locate ASCs along the DTN to efficiently provide overnight stopover accommodations for the Special Transportation Vehicle (STV);
- o Locate ASCs in "suitable" terrain but without loss of shelter sites;
- o Arrange ASCs so that the combined service areas cover all shelter locations; and
- o Consider proximity to major highways and local communities as being desirable.

In addition to these basic criteria, there were a number of other siting requirements in the form of exclusions and considerations. Operational requirements are listed in Table 5-1, Table 5-2 lists geotechnical and environmental requirements, and Table 5-3 covers the geographical requirements. In all three tables, exclusions mean that the area is not suitable for siting and considerations mean that the area is not preferred for siting but may be used if necessary.

SHELTERS AND AREA SUPPORT CENTERS (ASCs)

I. EXCLUSIONS:

- Quantity Distance (QD) Stand Off:
  - Existing road with an average daily traffic (ADT) greater than 50 vehicles per day: 2965' from centerline of road to HSS and CMF
  - Inhabited buildings: 2956' from CMF and HSS
  - Pipelines: 300'
  - Above ground Petroleum Oils, Lubricants (POL): 1800'
  - Radio, microwave facilities: 2965' from CMF and HSS
  - Power generating facilities: 5 statute miles
- Cluster roads cannot coexist with or cross federal, state, and county roads with an ADT of 250 vehicles per day

II. CONSIDERATIONS:

- Powerline; QD to all MX facilities:
  - Less than 50 kV : 750'
  - 50 kV to 250 kV: 1250'
  - More than 520 kV: 2500'
- Powerlines; QD to manned MX facilities with radio communications facilities:
  - Less than 45 kV: 100'
  - 45 kV and greater: 5000'
- Cluster Siting:
  - Clusters to be located so as to minimize the number of inhabited buildings within the QD zones
  - Clusters should be reasonably close to other clusters in the DDA
  - Locate clusters in areas with a minimum of medium to tall vegetation
- Cluster Roads:
  - Site MPSs to permit the CRN to be oriented North to South to the greatest extent possible
  - The CRN may coexist with or cross roads with an ADT less than 250 vehicles per day
  - Minimize environmental impact by coexisting with unpaved county roads of all other factors are equal
  - The CRN may cross from one siting area to another through unsuitable area as long as slope requirements and environmental exclusions are not violated
  - Slope requirements:

    Nominal trunk and spur grades: maximum three percent

    MPS access ramp grade: maximum five percent

    Occasional grades of five percent may exist for a maximum of 500' sections
  - The CRN for a cluster will be separate from any other cluster
- Operational Support Roads (OSRs):
  - May connect CRNs, but shall preclude STV or TEL entrance or exit
  - Slope requirement: maximum 10 percent grade

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SYSTEM SITE – SELECTION
OPERATIONAL REQUIREMENTS
PAGE 1 OF 2

6 NOV 81 TABLE 8-1

DESIGNATED TRANSPORTATION NETWORK (DTN)

I. **EXCLUSIONS:**

- Road grade greater than seven percent

II. **CONSIDERATIONS:**

- Should not cross railroad
- Cost effectiveness (construction cost vs. operating cost)
- Minimum grade
- Shortest road length
- Minimum elevation

OPERATIONAL BASE TEST SITE/DESIGNATED TRAINING AREA (OBTS/DTA)

I. **EXCLUSIONS:**

- Four - mile separation (from shelter centerline to)
  - OB/DAA
  - Airfields
  - Railroads
  - Major highways or major service road
  - DTN
  - Powerlines greater than 250 kV
  - Mining or processing plants
- One - mile separation from pipelines
- Approximately 3000' of the cluster road network with average of three percent grade with a maximum of five percent grade for not more than 5000'
- One shelter to face magnetic west
- The DTA shall be sited adjacent to the OBTS but outside the "No public use"area
- Locate within OB siting bubble and/or EIS boundary
- The "No public use" area is the zone 1 mile from the centerline of each OBTS shelter, the CMF, and the cluster road

II. **CONSIDERATIONS:**

- An additional area 0.9 to 1.5 miles outside the "No public use" area would allow all public use on a noninterference basis
- Minimize driving distance from OB/DAA

GEOTECHNICAL

I. EXCLUSIONS:

- Outcropping or shallow rock
- Surface slope greater than 10 percent
- Adverse terrain (two or more drainages 10' deep within 1000').
- Standing water, swamps, or perennial streams
- Depth to rock less than 50' (i.e. material with a seismic velocity of 7,000 fps)
- Depth to water less than 50' (i.e. first encountered water)
- Active playas

II. CONSIDERATIONS:

- Fault rupture hazard
- Potential sheet wash
- Surface slope greater than five percent
- Dunes
- Dessication cracks
- Tufa
- Boulder fields

ENVIRONMENTAL

I. EXCLUSIONS:

- Designated Wilderness Areas
- Wilderness Study Areas
- Existing/Proposed Federal and State
  - Wildlife refuges, archaeological areas
- Existing/Proposed National
  - Wildlife refuges, preserves, registered archaeological properties
- Federal Threatened and Endangered Species
- Non-attainment Air Quality Areas

II. CONSIDERATIONS:

- Federal and state proposed Threatened and Endangered Species
- Locally identified "sensitive" areas
  - Environmentally
  - Socio-Economically
- Visual Resources

SYSTEM SITE–SELECTION
GEOTECHNICAL/ENVIRONMENTAL
REQUIREMENTS

GEOGRAPHICAL

I EXCLUSIONS:

- Existing/proposed federal and state:
  - Parks, landmarks, refuges, monuments, forests, recreational areas
- Existing/proposed national:
  - Grasslands, Indian reservations, ranges, military ranges (training areas, proving grounds, test site), registered historic properties
- Radii from population centers:
  - 20 statute miles from cities of 25,000 or more
  - 3.5 statute miles from cities of 5,000 to 25,000
  - 1 statute mile from cities of less than 5,000
- Inhabited buildings
- Industrial complexes:
  - Active mining areas, tank farms, pipeline complexes
- "High" potential mineral areas: *
  - Oil and gas fields, active and potentially mining areas, strippable coal, oil shale, uranium deposits, known geothermal resource areas
- COE recommended exclusions

II CONSIDERATIONS:

- Private property
- State property
- "Good" potential mineral areas: *
  - Oil and gas, active and potentially active mining areas, strippable coal, oil shale, uranium deposits, known geothermal resource areas
- Irrigated farmland
- Prime aggricultural land
- Moapa Indian Expansion Area
- Duckwater Indian Expansion Area
- Ranch and grazing allotments
- Existing access roads
- Proposed utility corridors

* Mineral potential to be determined by a study as required by FLPMA

NOTE:

1. EXCEPT DTN

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SYSTEM SITE–SELECTION GEOGRAPHICAL REQUIREMENTS

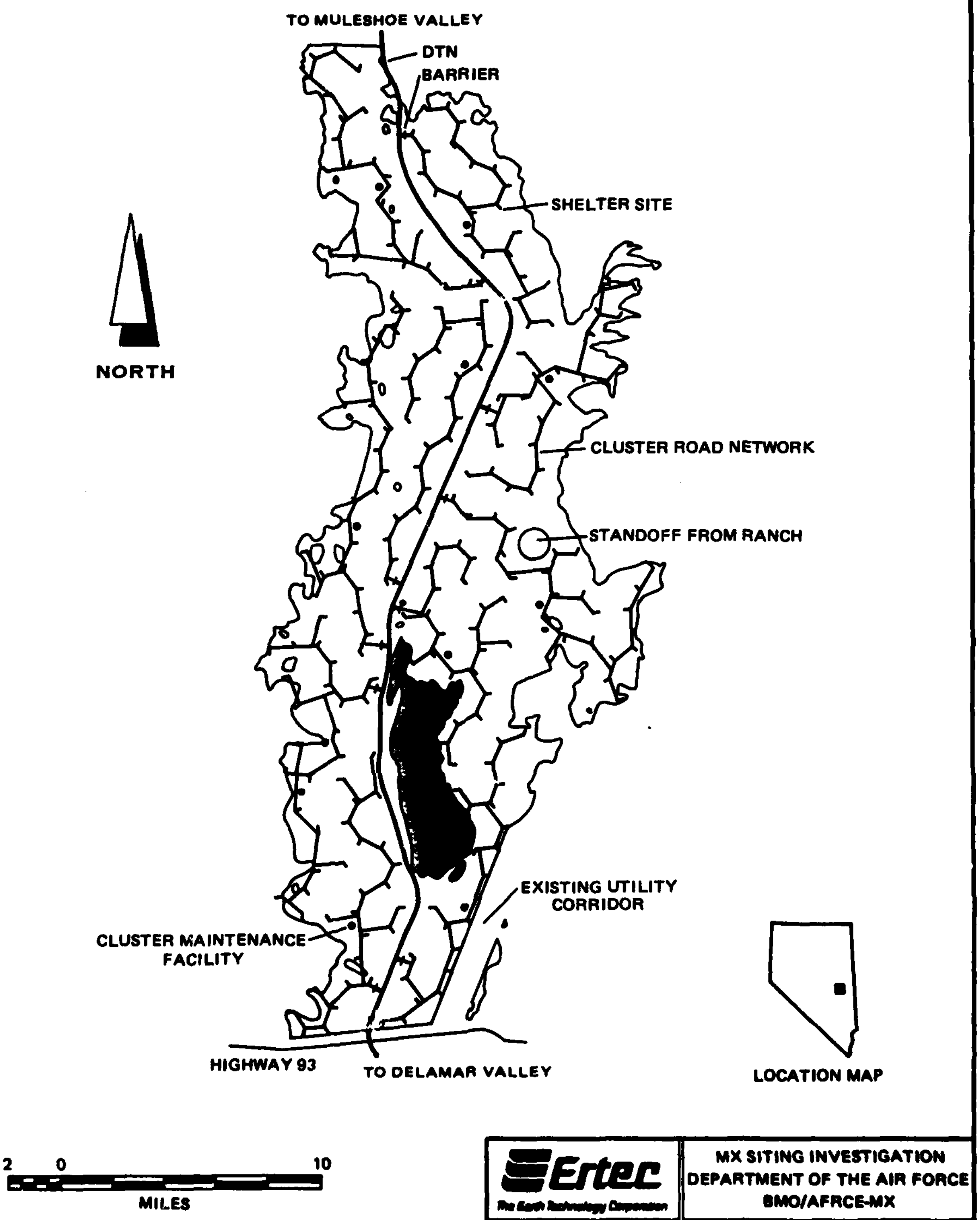
6 NOV 81 TABLE 5-3

5.4 FY 81 SITING ACTIVITIES

The FY 81 siting activities consisted of a continuation of those programs which were started in FY 80. Shelter layouts and DTN routing, which were once again the major activities, continued during the entire year. OBTS siting became an important program in the last quarter of the year. The one new activity, which was added to the FY 81 program, was a series of field programs. These included preliminary environmental resources inventories at three candidate OB sites, field surveys in the IOC valleys, and field surveys for some OBTS sites and segments of the DTN. The details of all these activities are described briefly in the following sections.

5.4.1 Shelter Siting Studies

Shelter Layouts was the major siting program in FY 81. Layouts were completed for nine valleys in Utah and 28 valleys in Nevada, and their locations are shown as the shaded areas in Drawing 5-1. Shelter sites are not shown on the map but the cluster roads are shown. The number of clusters (i.e., 23 shelters per cluster) per valley is listed in Drawing 5-1. Initial layouts were completed and submitted to BMO/AFRCE on 15 May 1981. At that time, 227 clusters were identified in the 37 valleys. The reduction to 200 clusters was to take place during the review process and as a result of more detailed studies in FY 82. A typical example of a valley layout is shown in Figure 5-3. The layout is for Dry Lake Valley, Nevada, where it was possible to site 10 clusters, (i.e., 230 shelters).



NOTE: 1. ASSUMES COYOTE SPRING MOB

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23/1 CLUSTERING, 5200' SPACING
2/3 HEXAGONAL PATTERN
DIRECT CONNECT CLUSTER ROAD NETWORK
DRY LAKE VALLEY, NEVADA
SCHEMATIC MPS LAYOUT 9/17/81

6 NOV 81

FIGURE 5-3

Following the submittal of the layouts, a number of activities continued. The Ertec Western layout team continued to update overlays, improve base maps, and perform quality assurance checks of the layouts. At the same time, AFRCE, BMO, and TRW personnel were reviewing the layouts and plans were being formulated for a state review process. Initial meetings with the states regarding the review process were held on 21 and 22 May and continued on a monthly basis through August. As a result of the state comments, layouts were revised and the process was expected to continue into FY 82. Table 5-4 depicts those valleys for which siting review comments had been received and also shows what other layout activities had been completed.

Other shelter siting studies which took place in FY 81 included:

- o Valley clustering at 5200-foot spacing for five valleys in Nevada and two valleys in Utah;
- o A variety of valley clustering scenarios to support 4600, 2300, and 1500 shelters for horizontal and vertical basing modes in Nevada and Utah; and
- o Completion of layouts of Pine and Wah Wah valleys at a scale of 1:9600 to support the field surveys (Section 5.4.6).

The details of shelter siting studies are discussed in Part I of the MX System Siting Summary Report (E-TR-58-I).

5.4.2 DTN/ASC Siting Studies

DTN/ASC siting studies began early in FY 81 and continued during the remainder of the year. The purpose of these studies was to determine the best routing for the DTN and the most suitable locations for the ASCs in the Nevada/Utah deployment

		1:62,500 LAYOUTS					1:9600 LAYOUTS
		15 MAY '81 BMO/AFRCE-MX SITING REVIEW (SUBMITTED)	BMO/AFRCE-MX SITING REVIEW (COMMENTS RECEIVED)	LAND PARCEL DESCRIPTIONS	VALLEY CLUSTERING 5200'	VALLEY CLUSTERING 1.73 mi	8 MAY '81 FIELD SURVEY
UTAH							
1. DUGWAY	DW	●					
2. FISH SPRINGS FLAT	FS	●					
3. PINE	PI	●	●	●	●		●
4. SEVIER DESERT	SD	●					
5. SEVIER LAKE	SL	●					
6. SNAKE	SV	●					
7. TULE	TL	●	●				
8. WAH WAH	WA	●	●	●	●		●
9. WHIRLWIND	WW	●					
NEVADA							
1. ANTELOPE	AN	●					
2. BIG SAND SPRINGS	BG	●					
3. BIG SMOKY	BS	●					
4. BUTTE	BV	●					
5. CAVE	CV	●	●				
6. COAL	CL	●					
7. DELAMAR	DM	●	●				
8. DRY LAKE	DL	●	●	●	●	●	●
9. GARDEN	GN	●					
10. HAMLIN	HV	●	●				
11. HOT CREEK	HC	●			●		
12. JAKES	JV	●					
13. KOBEH	KB	●					
14. LAKE	LV	●	●		●		
15. LITTLE SMOKY	LS	●					
16. LONG	LG	●					
17. MONITOR	MV	●					
18. MULESHOE	MS	●	●		●		
19. NEWARK	NK	●					
20. PAHROC	PA	●	●				
21. PENOYER	PN	●					
22. RAILROAD	RR	●					
23. RALSTON	RV	●					
24. REVEILLE	RE	●					
25. SPRING	SP	●	●		●		
*26. STEPTOE	SO	●					
27. STONE CABIN	ST	●					
28. WHITE RIVER	WR	●					

* STEPTOE VALLEY DELETED FROM FURTHER SITING STUDIES AS OF SEPTEMBER 1981

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SUMMARY OF MULTIPLE PROTECTIVE SHELTER LAYOUTS

6 NOV 81 TABLE 9-4

area. Limited DTN studies were performed in New Mexico to support the siting of the OBTS/DTA options. The details of the DTN/ASC siting studies are discussed in Part II of the MX System Siting Summary Report (E-TR-58-II) and are summarized in the following paragraphs.

The DTN studies consisted of field reconnaissance and office studies to determine the optimum routes. Close coordination with the shelter layout program was necessary to integrate these two activities into a compatible system which met all the operational requirements, satisfied all the exclusion requirements, and considered all of the geotechnical, environmental, and geographical factors. Initial studies concentrated on the first 360 miles (576 km) of the DTN. When this phase of the study was completed, the routing was depicted on 1:62,500 base maps which had been developed by the Ralph M. Parsons Company.

These maps were submitted to the AFRCE and copies were given U.S. Army Corps of Engineers so they could prepare bid documents for final routing and design study contracts.

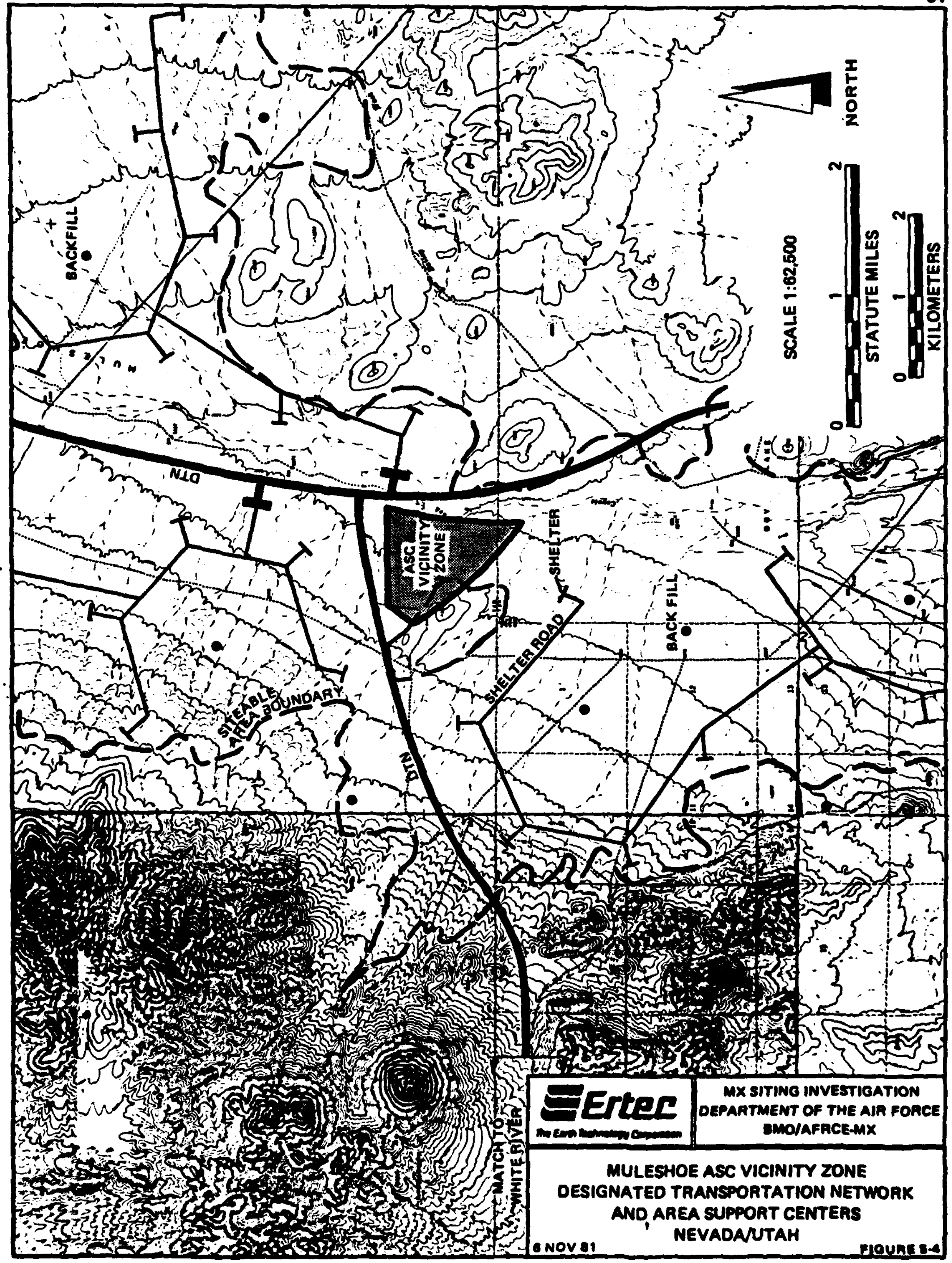
As the DTN studies were completed, the selected routes were added to the valley shelter layout maps at the 1:62,500 scale. The routing was also shown on a regional map at a scale of 1:500,000 and updated periodically as the work progressed. The final routing is shown in Drawing 5-1. For a MOB at Coyote Spring, Nevada, the total length of the DTN is 1426 miles (2282 km).

The ASC siting studies were coordinated with the DTN studies since the ASCs were to be located adjacent to the DTN. Based on the primary criterion that ASCs be located within 65 miles (105 km) of shelter sites, it was determined that four ASCs would be needed to cover the 37 valleys in the Nevada/Utah deployment area. One mi^2 (2.6 km^2) vicinity zones were evaluated and final sites were selected which met all the criteria and, at the same time, did not infringe on shelter sites. The selected sites are shown in Drawing 5-1. The site in Muleshoe Valley is shown in Figure 5-4 to show the relationship between the DTN, shelter sites, and the ASC.

5.4.3 OBTS/DTA Siting Studies

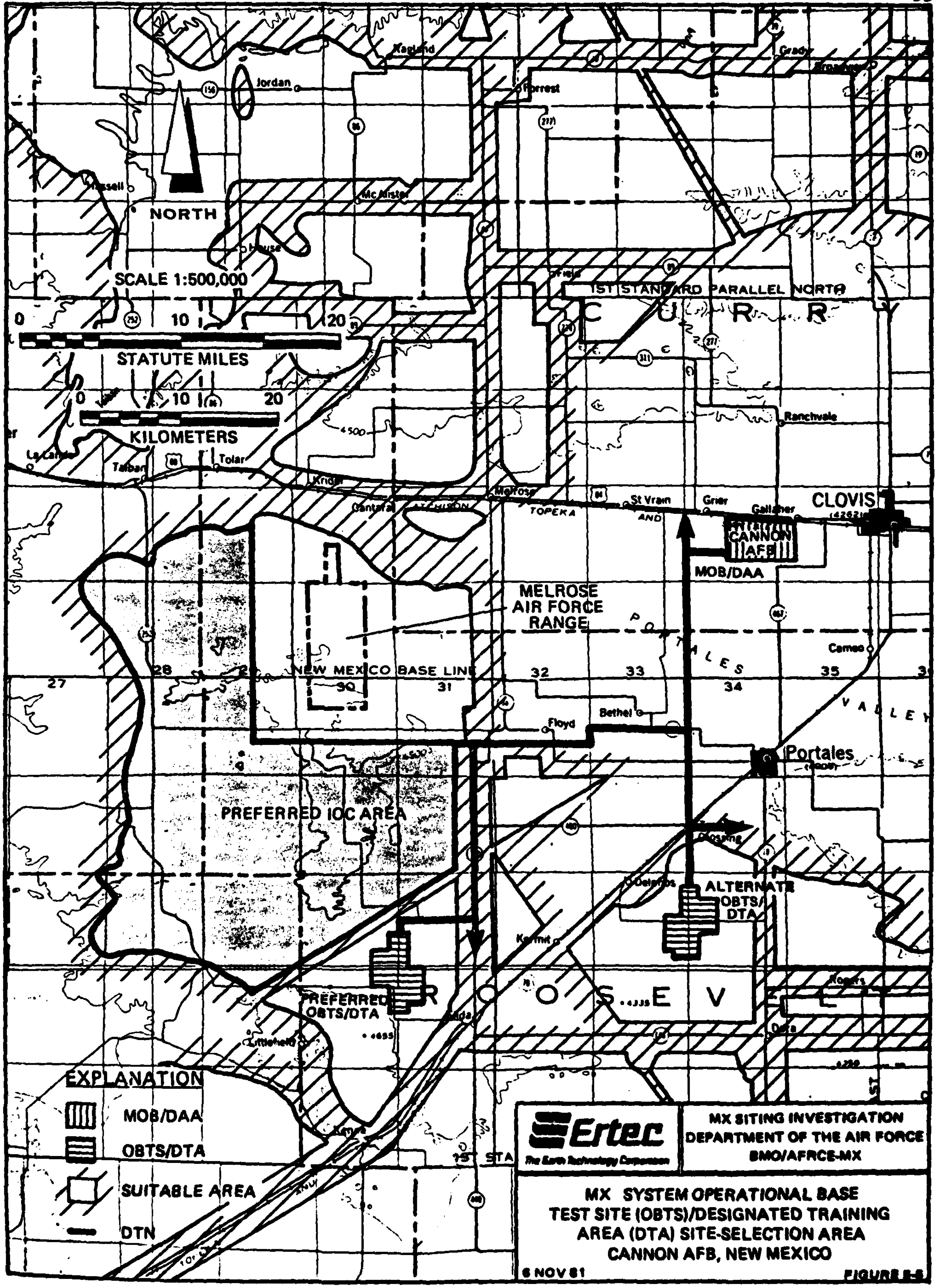
OBTS/DTA siting studies were performed in Nevada, Utah, and New Mexico in the last quarter of FY 81. These studies were coordinated with the in-house shelter and DTN studies and with OB studies being performed by the base comprehensive planner (EDAW). The details of these studies are discussed in Part III of the MX System Siting Summary Report (E-TR-58-III) and are briefly summarized in the following paragraphs.

Preferred and alternative OBTS/DTA sites were selected for each of the MOB/DAA sites at Coyote Spring, Nevada, Beryl and Milford, Utah, and near Cannon Air Force Base (AFB), New Mexico. For the study in New Mexico, the initial step was to select a preferred IOC area (Figure 5-5). At each site, preferred and alternative layouts conforming to BMO criteria and requirements were produced at a scale of 1:62,500. Figure 5-6 presents an example of a layout in Coyote Spring Valley, Nevada.



MULESHOE ASC VICINITY ZONE DESIGNATED TRANSPORTATION NETWORK AND AREA SUPPORT CENTERS NEVADA/UTAH

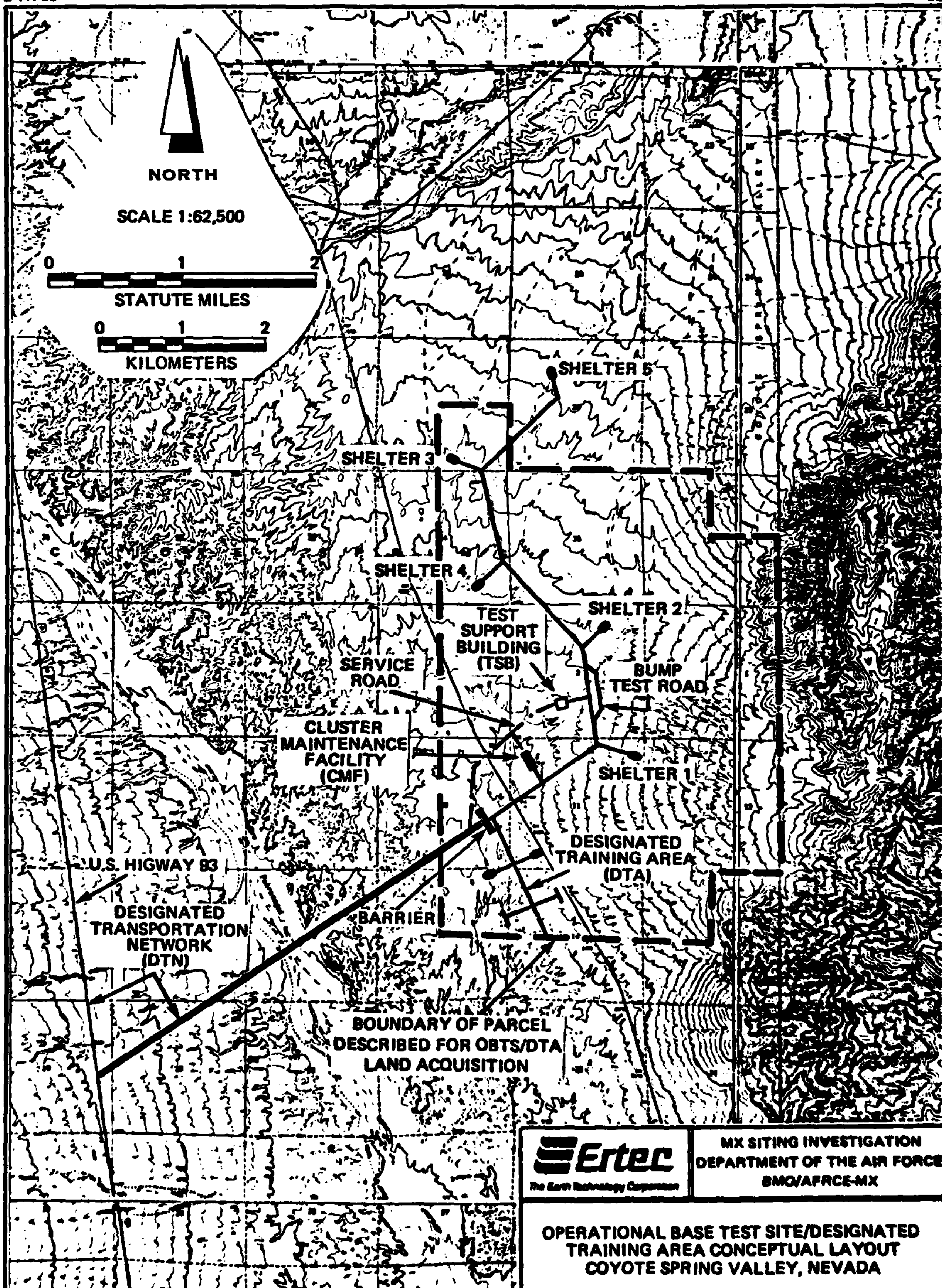
FIGURE 5-4



MX SYSTEM OPERATIONAL BASE TEST SITE (OBTS)/DESIGNATED TRAINING AREA (DTA) SITE-SELECTION AREA CANNON AFB, NEW MEXICO

6 NOV 81

FIGURE 8-6



OPERATIONAL BASE TEST SITE/DESIGNATED TRAINING AREA CONCEPTUAL LAYOUT COYOTE SPRING VALLEY, NEVADA

6 NOV 81 FIGURE

The final OBTS/DTA layouts were 1) given to the environmental assessment contractor in support of the tiered decision-making process, 2) used for the OBTS/DTN field surveys, 3) depicted on the regional map (Drawing 5-1), and 4) incorporated in the Land Acquisition Package.

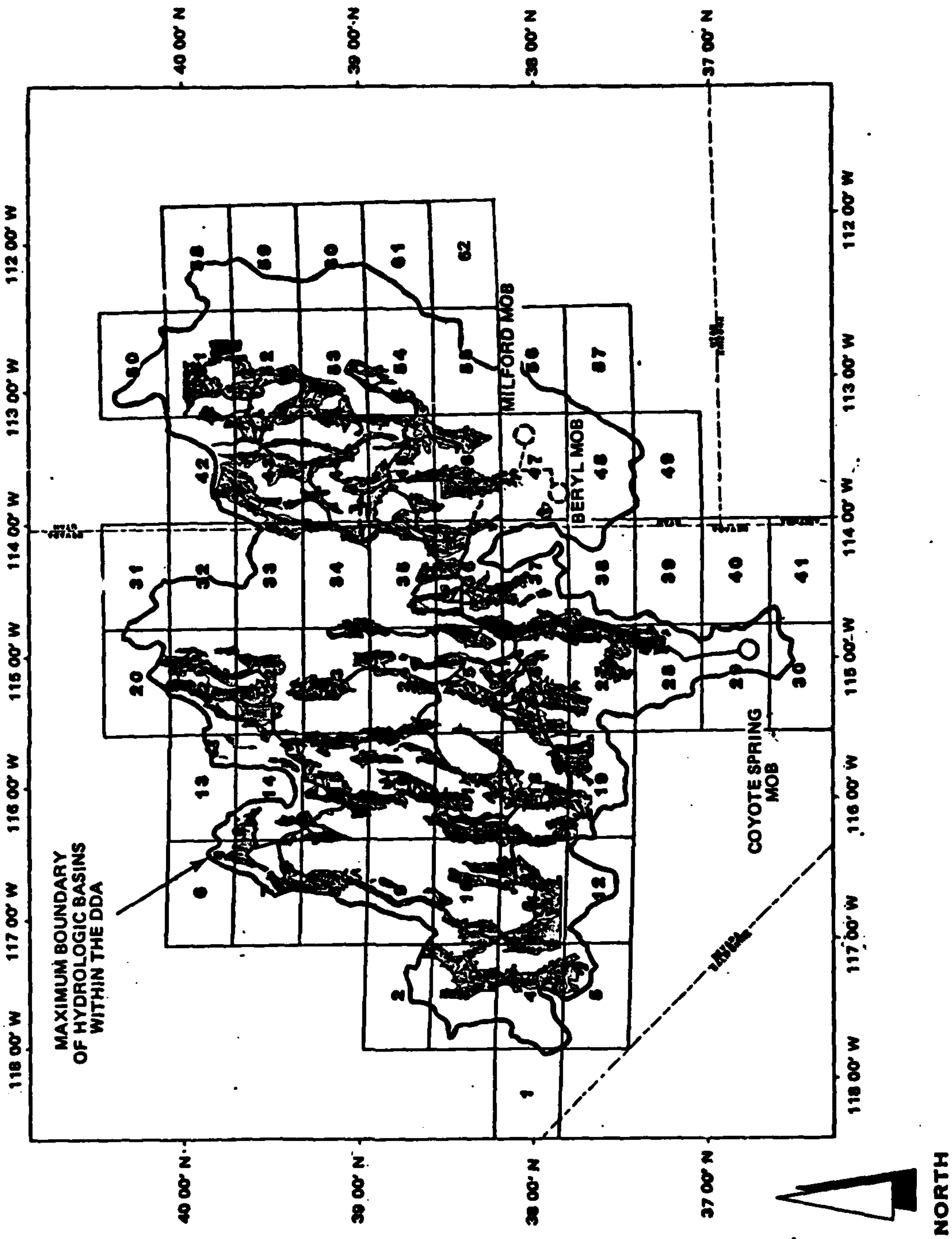
5.4.4 Land Acquisition Package

A primary purpose of the FY 81 siting studies was to prepare maps depicting MX facilities for incorporation in the Land Acquisition Package. If the MPS-MX system had continued, this package would have been submitted to BLM for their review and then forwarded to Congress as part of the process of withdrawing BLM lands for use by the Department of Defense.

The Land Acquisition Package consisted of the following elements:

- A regional map at a scale of 1:500,000 showing the system layout (similar to Drawing 5-1);
- Base maps at a scale of 1:62,500 depicting shelter sites, cluster roads, DTN routes, ASC sites, MOB and OBTS/DTA site options, borrow areas, utility corridor, access roads, etc.; and
- Land parcel descriptions of all facilities (legal descriptions).

The base maps consisted of a series of standard "E" size maps which covered the entire Nevada/Utah deployment area. A grid was developed as shown in Figure 5-7; it consisted of 62 map sheets. Eighteen of these were used in the initial Land Acquisition Package, and the remaining map sheets were in various stages of development at the end of FY 81.



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**'E' SIZED (1:62,500) BASE MAP INDEX
DESIGNATED DEPLOYMENT AREA (DDA)
NEVADA/UTAH**

6 NOV 81

FIGURE 5-7

The initial Land Acquisition Package had just been completed and reviewed by AFRCE-MX when President Reagan made the decision to terminate the MPS-MX system.

5.4.5 Preliminary OB Site Environmental Resource Inventories

Preliminary OB environmental resource inventories were performed for the proposed OB sites at Coyote Spring, Nevada, and Milford and Beryl, Utah. The purpose of these studies was to determine if there were any environmental "show-stoppers" which might preclude the use of these sites. The office and field studies included preliminary data on wildlife species and habitats, plant species, a literature review of the abiotic and biotic environments, vegetative associations, a literature review of cultural resources, consultations with agencies and academic personnel, and field visits of potential cultural resource sites. The results of these studies are presented in a report identified as FN-TR-46.

5.4.6 Field Surveys in IOC Valleys

In the first half of FY 81, field surveys were conducted in three valleys which had been selected because of their potential of becoming the valleys for initial construction to meet the IOC schedule of having 10 clusters operational by mid-1986. For discussion purposes, these valleys are referred to as the IOC valleys. The purposes of the surveys were to test cluster layout procedures and evaluate potential field problems at specific shelter sites. Dry Lake Valley, Nevada, was selected as an IOC valley because it was large enough to support 10

clusters and was relatively close to the proposed Main Operational Base (MOB) site in Coyote Spring Valley. Pine and Wah Wah valleys, Utah, were selected because they were the closest valleys to proposed MOB sites near the towns of Beryl and Milford and, together, could support 10 clusters. The results of these surveys are presented in three volumes of report number E-TR-48. Table 5-5 summarizes the results of the surveys in terms of the number of sites which were relocated for archaeological, biological, geotechnical, or cultural reasons. Because some sites were relocated, other sites also had to be moved to meet siting criteria; these relocations are also listed at the bottom of the table. For all three IOC valleys, a total of 71 sites were relocated but only 10 of these sites were resited for archaeological, biological, or cultural reasons.

The field surveys did verify that the general siting process methodology was acceptable regarding the application of siting requirements, suitable area boundaries, and the use of 1:9600 base maps. The one weakness was in the fact that the siting review process had not been finalized at the time the field surveys were initiated, and some later changes in layouts were being considered as a result of input from the states.

5.4.7 <u>DTN/OBTS Field Surveys</u>

The field surveys were performed at four OBTS sites; one at the Coyote Spring MOB, Nevada, one at the Beryl MOB, Utah, and two at the Milford MOB, Utah. An alternate OBTS at the Beryl MOB

	NEVADA	UTAH	
	Dry Lake Valley	Pine Valley	Wah Wah Valley
Number of Clusters	10	5	5
Number of Shelters	230	115	115
Number of CMFs	10	5	5
Number of RSSs	5	4	4
DTN	39 miles (62 km)	0	0
Cluster 2 Roads	30 miles (48 km)	0	0

	NEVADA		UTAH					
	Dry Lake Valley		Pine Valley		Wah Wah Valley		Total IOC Valleys	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Archaeological	3	13	1	4.5	2	8	6	8
Biological	0	0	1	4.5	0	0	1	1
Geotechnical:								
Fault	2	9	1	4.5	0	0	3	4
Bedrock	1	4	0	0	1	4	2	3
Earth cracks	2	9	0	0	0	0	2	3
Wash in front of shelter	3	13	4	18	4	15	11	15
Wash affecting shelter	6	26	4	18	7	27	17	24
Wash at rear of shelter	1	4	6	27	2	8	9	13
Playa	0	0	1	4.5	0	0	1	1
Cultural	0	0	3	14	0	0	3	4
Criteria	5	22	1	4.5	10	38	16	23
Totals	23		22		26		71	

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SUMMARY OF SURVEYED AND RELOCATED SITES

6 NOV 81

TABLE 9-6

and two OBTSs near Cannon AFB, New Mexico, MOB were not surveyed because permission to enter onto private land at these sites had not been obtained at the time of the field surveys.

Biological resources surveys and geotechnical inspections were also made along the DTN route from each MOB toward the IOC valleys, along one road corridor from the Coyote Spring MOB to the OBTS, and along one OBTS road from the Beryl MOB. The other OBTS road connections could not be surveyed because authorization to enter private land was not granted at the time of the field surveys. The areas surveyed in Nevada and Utah are shown in Figures 5-8 and 5-9, respectively. Figure 5-8 shows the 72-mile (116-km) segment of the DTN in Nevada along which biological surveys and geotechnical inspections were made. Figure 5-9 shows a 64-mile (103-km) segment of the DTN in Utah where similar surveys and inspections were made.

Preliminary results of the studies indicated that the OBTS sites in Nevada and Utah and the DTN segments which were studied were environmentally and geotechnically acceptable. Unfortunately, it was not possible to complete the field surveys because of a stop work order issued on 14 October 1981. The directions were to compile data reflecting the status of the program as of 2 October 1981. These data were compiled in an unfinished report designated as E-TR-59.

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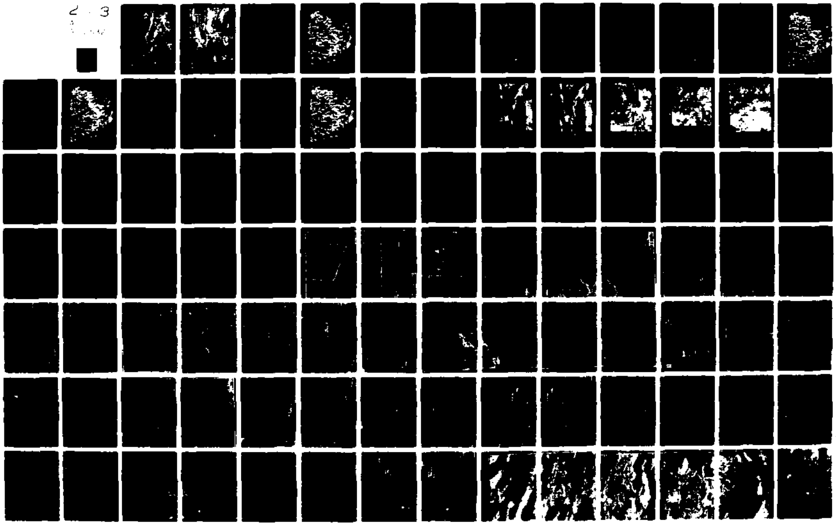

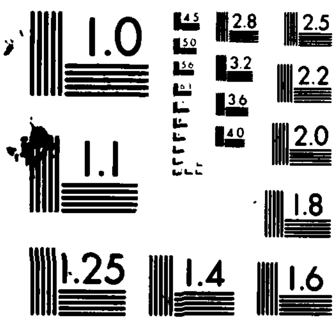

MICROCOPY RESOLUTION TEST CHART
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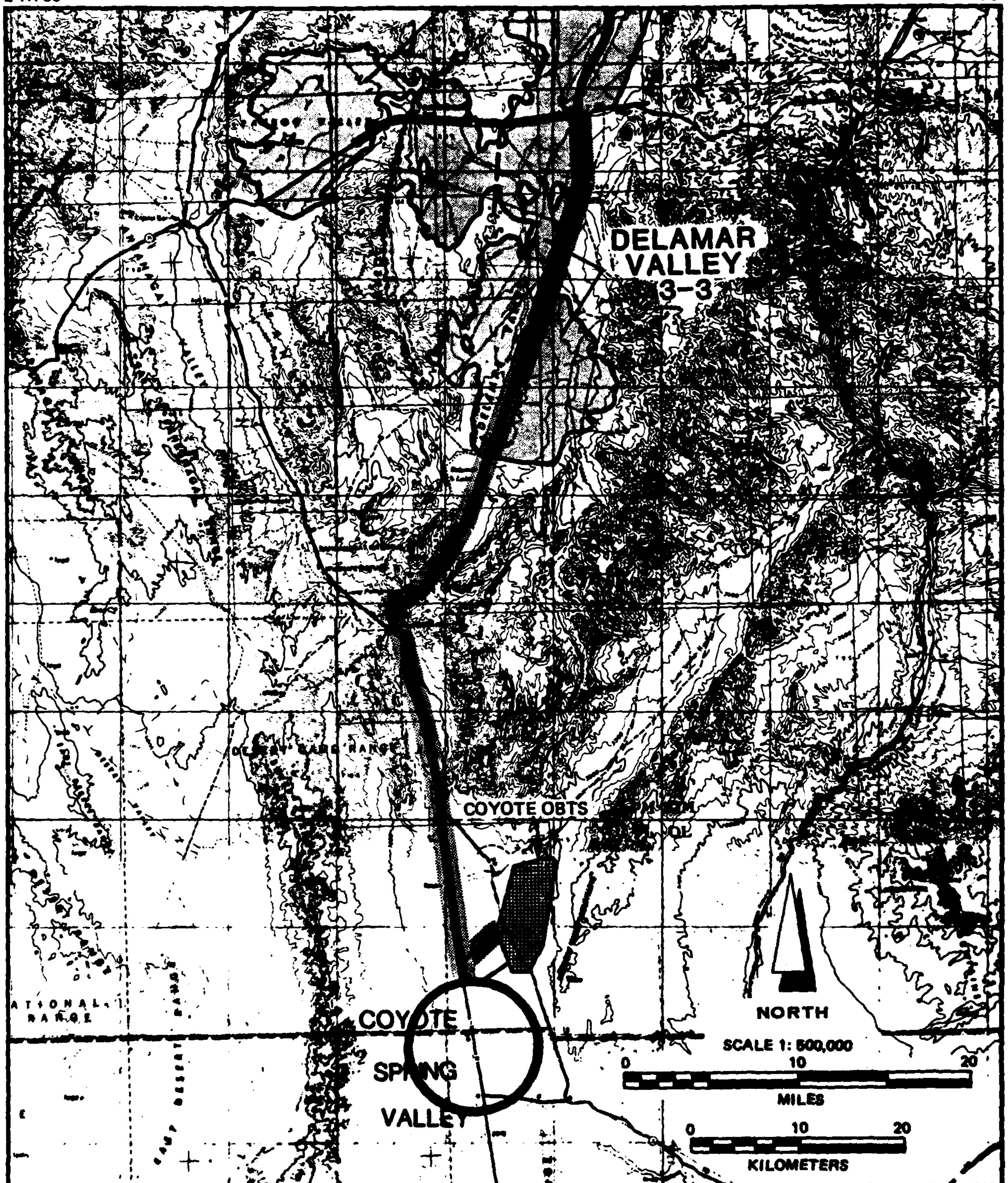

EXPLANATION

OBTS STUDY AREA

SEGMENT OF DTN OR OBTS ROAD STUDIED

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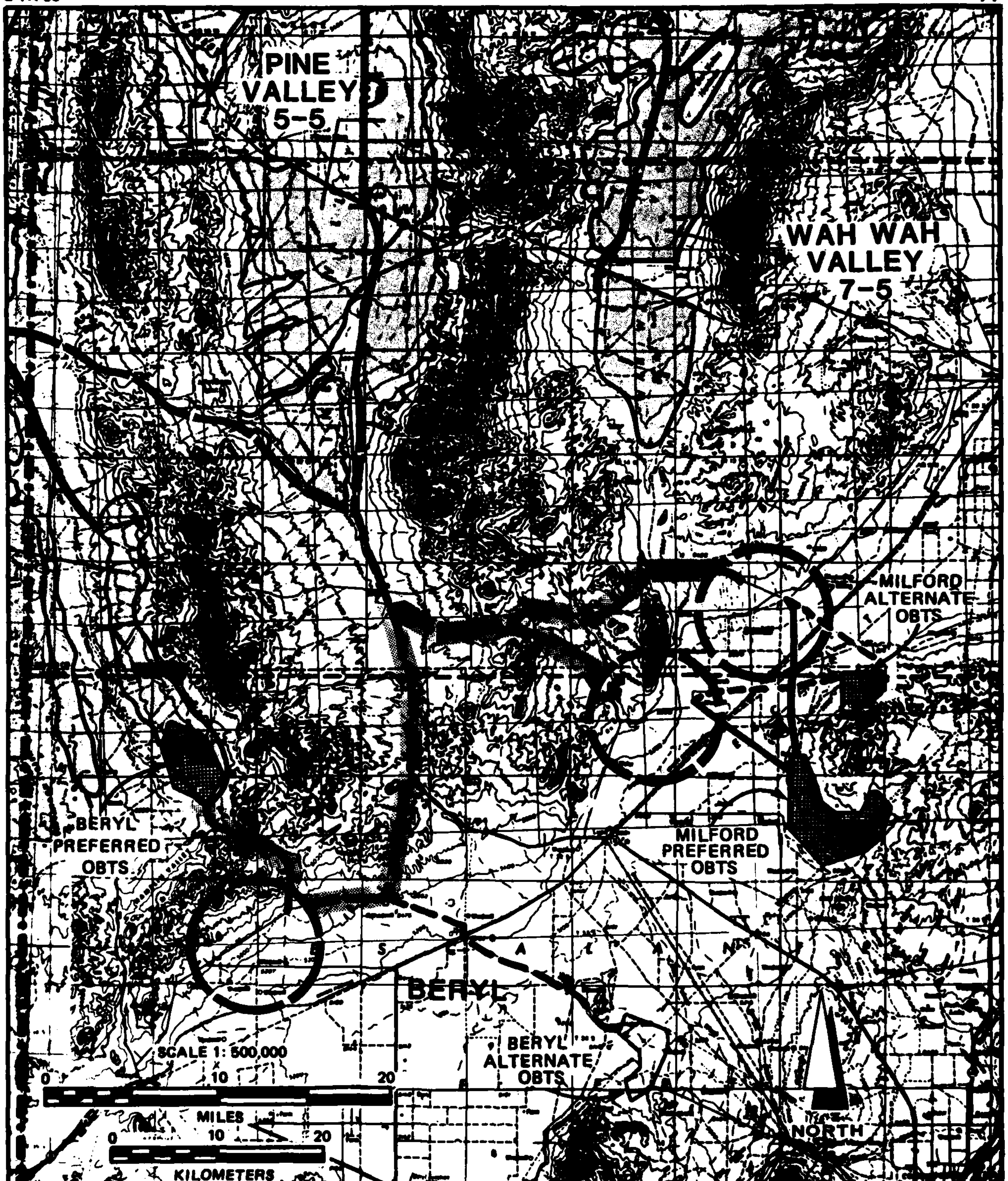
LOCATION OF SURVEYED SITES/ALIGNMENTS
COYOTE SPRING, NEVADA, MOB AREA
DTN/OBTS FIELD SURVEYS
AS OF 8/24/81

6 NOV 81

FIGURE 6-6



EXPLANATION

OBTS STUDY AREA

PROPOSED OBTS (NO FIELD SURVEYS PERFORMED)

SEGMENT OF DTN OR OBTS ROAD STUDIED

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LOCATION OF SURVEYED SITES/ALIGNMENTS
BERYL/MILFORD, UTAH, MOB AREA
DTN/OBTS FIELD SURVEYS
AS OF 8/24/81

6 NOV 81

FIGURE 8-8

6.0 SUPPORT PROGRAMS

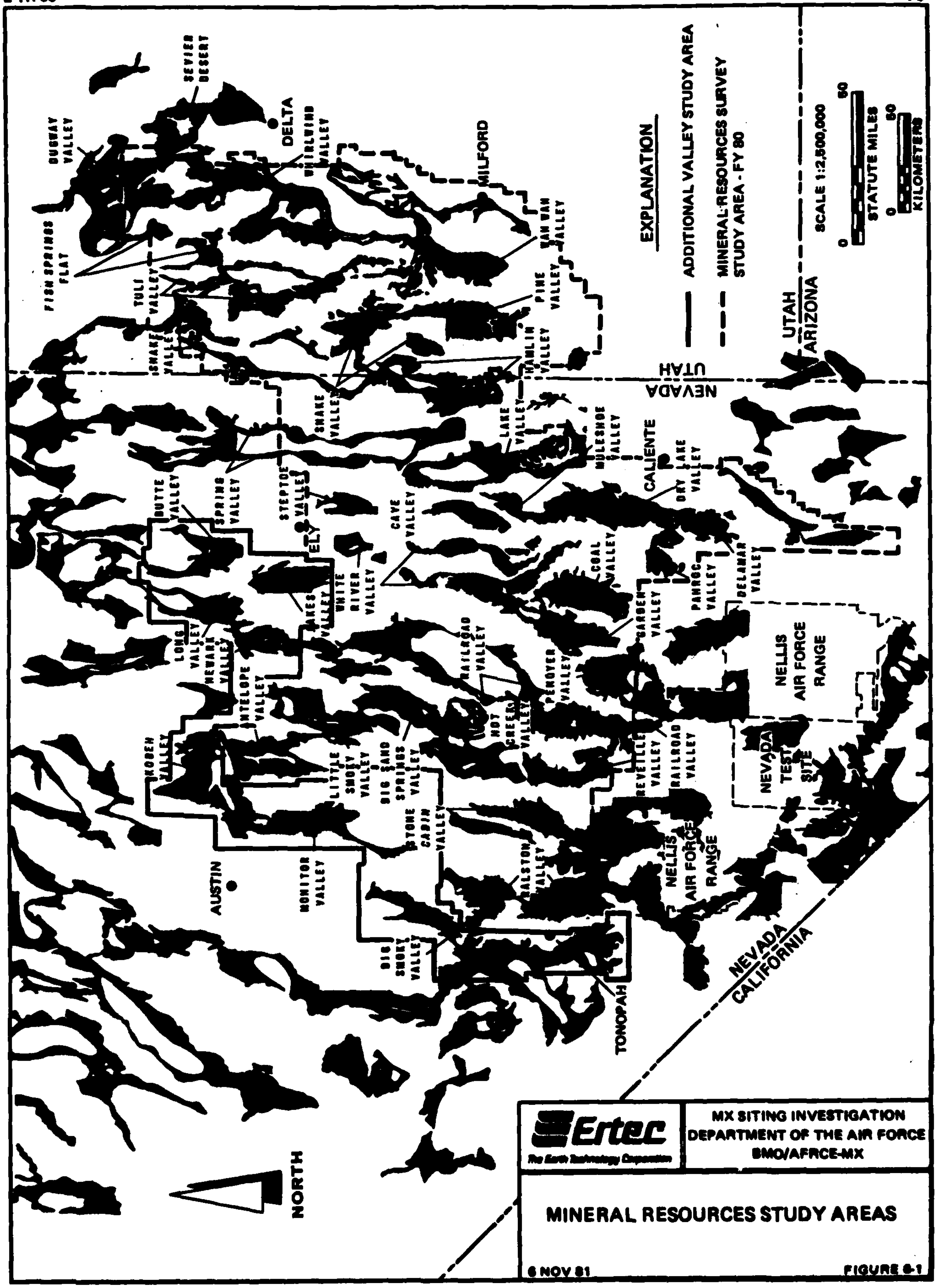
6.1 MINERAL RESOURCES SURVEYS

6.1.1 Background, Objectives, and Approach

In June 1980, Ertec was tasked to carry out a mineral resources survey of the MX siting area in Nevada and Utah (Figure 6-1). The survey was done to develop the necessary information on mineral and energy resource potential to accompany the MX application for land withdrawal. The scope of the survey was guided by the regulations for land withdrawal contained in the Federal Land Policy and Management Act of 1976.

The objective of the Mineral Resources Survey was to inventory and evaluate past and present mineral and energy resource activities in the MX siting area. This was to be done in sufficient detail so that potential future mineral exploitation in the MX deployment areas and the impacts of the MX system on future mineral activity could be assessed.

The survey drew heavily on existing published and unpublished data such as geologic and structural data; mine and mining district reports; aeromagnetic, seismic, and gravimetric data; and an inventory of all claims and leases. These data were supplemented by an update of the claim and lease inventory, a review of existing high altitude aerial photography and remote sensing data, contact with mining companies and individuals with interests in the siting area, field examination of significant mineral occurrences and major active mining operations, and consultation with experts knowledgeable of present and



MINERAL RESOURCES STUDY AREAS

FIGURE 6-1

future resource potential in the area. Evaluation of the mineral resources of the entire MX siting area provided a framework within which the resource potential in the MX deployment areas could be assessed. In addition, the potential market demands of the mineral commodities in the siting area were considered.

6.1.2 Mineral and Energy Resources Setting

The Basin and Range geologic province, which includes the MX siting area, is one of the most highly mineralized areas in the United States. Sedimentary and igneous rocks, as well as the overall tectonic framework of the Basin and Range province, have both contributed to the formation and localization of economic deposits of metals, nonmetallic minerals, and oil and gas. This localization has generally occurred along major metallogenic provinces or "mineral belts" in Nevada and Utah.

The mountain-valley physiography which typifies the Great Basin area of the Basin and Range province has largely limited historical mineral exploitation to the exposed mountain areas, while the alluvium-filled valleys have been little explored. More recent exploration has drifted toward the valley areas where favorable geologic conditions exist beneath the valley-fill materials.

The principal metals produced in the siting area are silver, gold, lead, zinc, copper, tungsten, molybdenum, uranium, and beryllium. The principal nonmetallic minerals are alunite, barite, and fluorspar.

Exploration for oil and gas in the Great Basin is still in its infancy. Structural complexity of the region deferred discovery and production until 1954 in Railroad Valley. Recent discoveries of major oil and gas fields within the overthrust belt of Utah and Wyoming have renewed exploration interests in its southern extension along the southeastern portion of the siting area. The current high level of exploration may lead to additional discoveries in the Great Basin.

6.1.3 FY 80 Mineral Resources Survey

A mineral resources survey covering 29 designated deployment valleys was completed and a report issued as a draft in January 1981. The Mineral Resources Survey considered four classifications of mineral potential; high, good, speculative, and low. Based on known mineral occurrences (including oil and gas) and favorable geologic environments within the siting area, evaluations of mineral potential for new economic discoveries to the year 2000 and beyond were made.

There are areas in the DDA that possess high or good potential for economical mineral deposits. The geologic ingredients necessary for the formation and storage of oil and gas are present in the siting area and areas of favorability have been identified. A summary of mineral and energy resource potential areas is presented in Table 6-1. Siting of the MX system could cause some hindrance of the mining and petroleum industries, mainly in the form of curtailment in size and scope of exploration, restriction in size of future mining operations, and

POTENTIAL	AREA (PERCENT MX DEPLOYMENT AREA)[1]		
	MINERAL	ENERGY	
		OIL AND GAS	GEOTHERMAL
HIGH	2	9	
GOOD	12	38	
SPECULATIVE	50	34	
LOW	36	19	
			19*
TOTAL	100	100	

*PERCENT FAVORABLE FOR LOW TO INTERMEDIATE TEMPERATURE GEOTHERMAL RESOURCES.

(1) FOR THIS STUDY MX DEPLOYMENT AREA EQUIVALENT TO GEOTECHNICALLY SUITABLE VALLEY AREA

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SUMMARY OF MINERAL AND ENERGY RESOURCE POTENTIAL AREAS – FY80 MINERAL RESOURCE SURVEY

6 NOV 81 TABLE 6-1

competition in the market-place for labor and materials. Construction of the system will, of necessity, spur the development and mining of aggregate and stone materials.

6.1.4 Seven Additional Valley Mineral Resources Survey

A supplemental mineral resources survey covering seven additional deployment valleys was completed and a report issued as a draft in June 1981. The seven valleys covered in this supplemental survey were added to the MX DDA adjoining the western and northwestern boundaries. This survey followed the same work scope as the FY 80 mineral resources survey. The same four classifications of mineral potential was used; high, good, speculative, and low.

The additional valley survey area includes the Montezuma Valley (part of southern Big Smoky Valley), Big Smoky, Monitor, Kobeh, and Jakes valleys and parts of Newark, Long, and Butte valleys. All of the western portion of the survey area falls within the highly mineralized Antler Orogenic Belt which itself is crossed by several regional lineaments and the very productive Manhattan Mineral Belt. Approximately half of the northern portion of the study area lies within the Eureka Mineral Belt which includes all of the major production centers in the northern portion of the study area except the Cherry Creek Mining district.

Both the western and northern portion of the study area are the sites of current mining operations and intense exploration. Oil and gas exploration is continuing in White Pine County in

the northeast portion of the study area, and some oil shale potential may exist in Eureka County in the extreme northwestern portion. Future development of new gold, molybdenum, tungsten, silver, lead, zinc, turquoise, barite, and possible copper and other industrial mineral resources in the study area is a certainty. The degree to which these resources are developed will depend on the availability of land, human resources, water resources, and ancillary resources necessary for mineral development. A summary of mineral and energy resource potential areas in the seven additional valleys is presented in Table 6-2.

6.1.5 Resources Land Status Survey of Deployment Areas

In December 1980, the BLM in Nevada/Utah requested the Resources Land Status Survey be updated from the FY 80 Mineral Resources Survey to include all claims and leases on file as of January 1981. This work was directed to provide a common level of inventory between the states.

Lists and descriptions of claims and leases were developed from county, state, and federal records. The survey included all mining claims (patented and unpatented), federal and state leases (oil and gas, geothermal, potassium, sodium, etc.) and state mineral leases within the MX deployment areas. This Resources Land Status Survey was completed in May 1981 and integrated into the Draft Mineral Resources Survey Report.

POTENTIAL	AREA (PERCENT MX DEPLOYMENT AREA) [1]		
	MINERAL	ENERGY	
		OIL AND GAS	GEOTHERMAL
HIGH	3	19	
GOOD	8	14	
SPECULATIVE	60	25	
LOW	29	42	
			2*
TOTAL	100	100	

* PERCENT FAVORABLE FOR LOW TO INTERMEDIATE TEMPERATURE GEOTHERMAL RESOURCES.

(1) FOR THIS STUDY MX DEPLOYMENT AREA EQUIVALENT TO GEOTECHNICALLY SUITABLE VALLEY AREA

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SUMMARY OF MINERAL AND ENERGY RESOURCE POTENTIAL AREAS — SEVEN ADDITIONAL VALLEY MINERAL RESOURCES SURVEY

6 NOV 81 TABLE 6-2

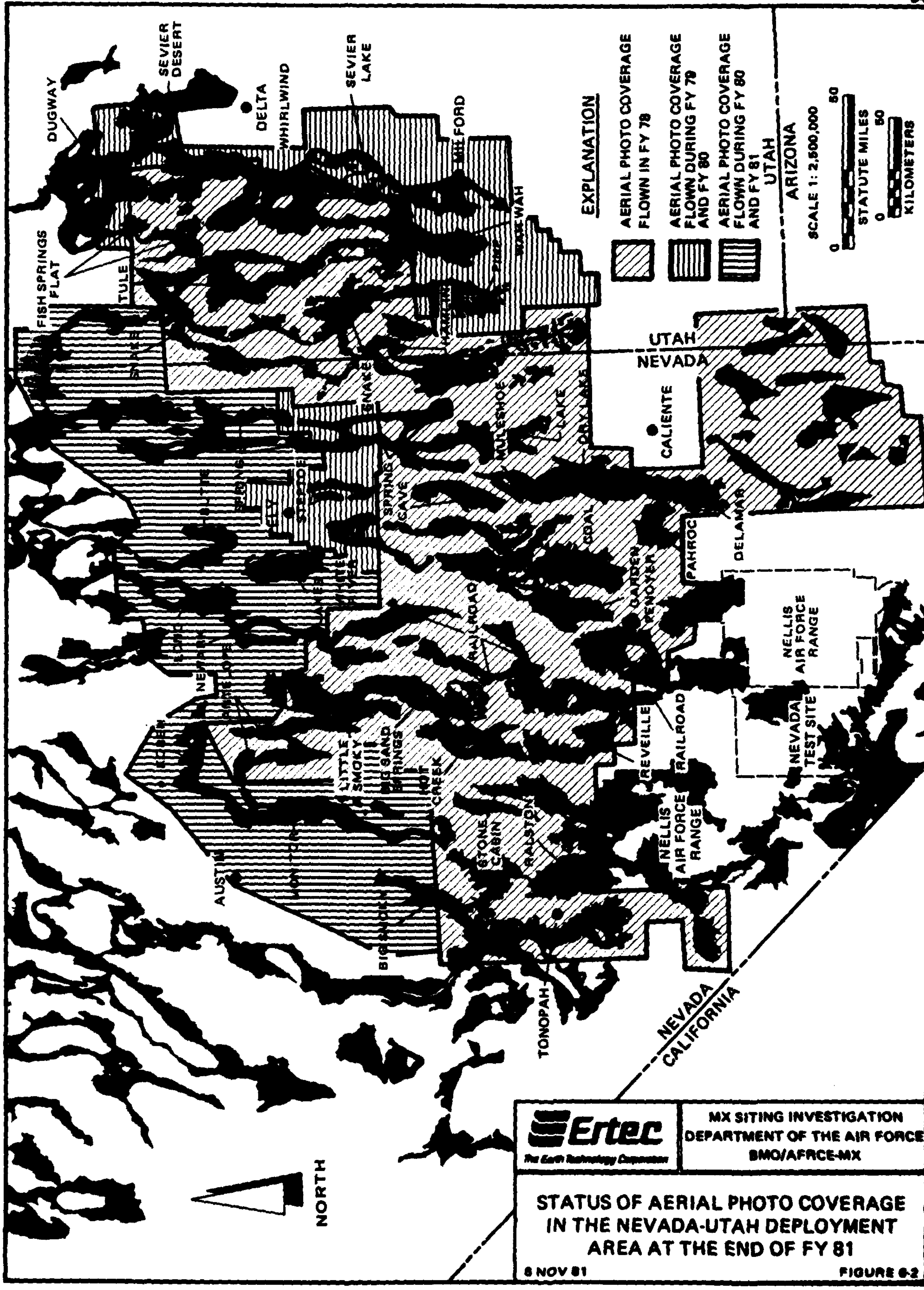
6.2 AERIAL PHOTOGRAPHY AND TOPOGRAPHIC MAPPING

6.2.1 Aerial Photography

In the latter part of FY 78, the Air Force authorized obtaining new 1:25,000 color photos for the deployment area in Nevada and Utah. A total of 8119 photographs were flown, covering an area of about 28,000 mi^2 (72,600 km^2) (Figure 6-2). These photos were used for the aerial photo interpretation task of the Verification program and other geotechnical, environmental, and siting tasks in subsequent years. These same photos were also used for producing topographic maps as discussed later in this section.

In the third quarter of FY 79, the Air Force authorized obtaining additional aerial photos. The area of coverage was extended to the east in Utah and to the south to cover the Union Pacific railroad and potential Operational Base sites. In eastern Nevada, the area of coverage was extended north around Ely to obtain photos for railroad access and basing studies. These two new areas of coverage are shown in Figure 6-2 and represent 2116 photos covering a total area of about 7400 mi^2 (18,900 km^2). At the same time, oblique aerial photos were taken of many of the valleys.

As siting studies continued in FY 80, it appeared that the area that had been identified for deployment of the MX-Multiple Protective Structure (MPS) system (31 valleys) was not large enough. It was recommended that the deployment area be extended to include six northern valleys in Nevada; Antelope, Butte, Kobeh, Long, Monitor, and Newark.



STATUS OF AERIAL PHOTO COVERAGE IN THE NEVADA-UTAH DEPLOYMENT AREA AT THE END OF FY 81

8 NOV 81 FIGURE 6-2

Flying for aerial photographs of these valleys began (Figure 6-2) in August 1980 and was completed in October. The area of coverage is nearly 11,000 mi^2 (28,500 km^2) and consists of 3085 exposures.

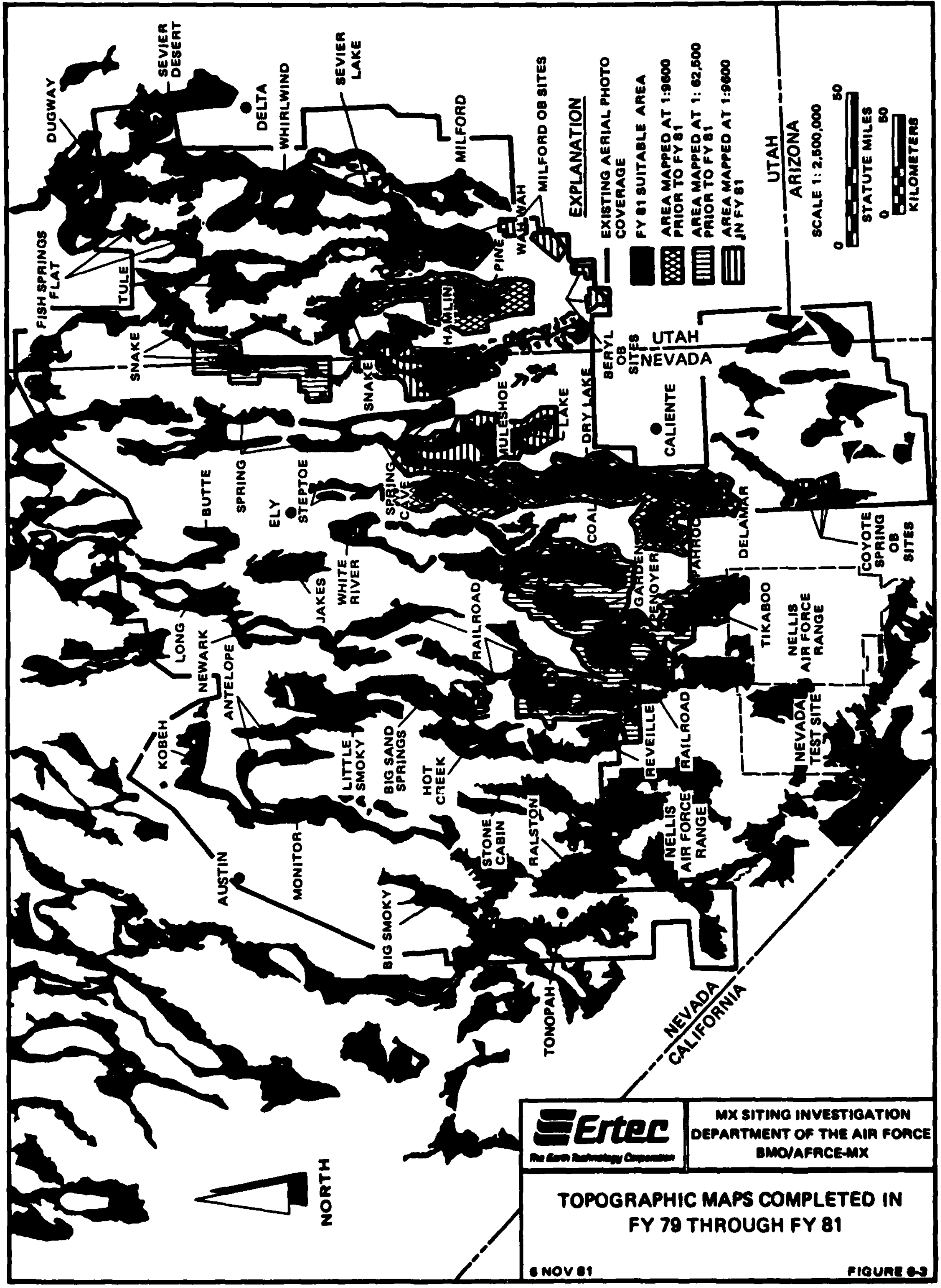
Combining the three different series of aerial photos, the total area of aerial photo coverage is 46,400 mi^2 and consists of 13,320 exposures.

6.2.2 Topographic Mapping

6.2.2.1 Background

Layout methodology studies for the MX-MPS basing mode were initiated in FY 79. Dry Lake Valley, Nevada, was selected as the valley for these studies and the program included the production of topographic map sheets of the valley at a scale of 1:4800. The contour interval was 5 feet (1.5 m) for the southern half and 10 feet (3 m) for the northern half. The map sheets were photographically reduced to a scale of 1:9600 and layouts were prepared at both scales. It was concluded from the results of the study that a map scale of 1:9600 was the most suitable for preliminary siting studies.

In FY 80, 1:9600 maps were produced for four valleys near Dry Lake Valley, Nevada; Delamar, Pahroc, Cave, and Muleshoe and two valleys in Utah; Pine and Wah Wah (Figure 6-3). Pine and Wah Wah valleys were potential IOC valleys, as was Dry Lake Valley, and the 1:9600 maps were used for the field surveys as



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TOPOGRAPHIC MAPS COMPLETED IN FY 79 THROUGH FY 81

6 NOV 81

FIGURE 6-3

discussed in Section 5.3 The number of map sheets and the dates the maps were completed are summarized in Table 6-3.

Layout studies in the DDA in Nevada and Utah were initiated in FY 80 as a follow on to FY 79 methodology studies. It was decided to prepare conceptual layouts at a scale of 1:62,500 (1 inch ≈ 1 mile). A review of existing USGS topographic maps determined that most of the DDA was covered by either 7.5 minute (1:24,000 scale) or 15 minute (1:62,500 scale) USGS topographic maps, but that there were a few areas where the most detailed maps available were 2° sheets (1:250,000 scale). It was concluded that maps at this scale were not of sufficient detail to produce conceptual layout drawings. The decision was made to produce new topographic maps at a scale of 1:62,500 with 10-foot (3-m) contour intervals for those deployment valleys where the most detailed maps available were the 2° sheets. This program was carried out in FY 80 and included producing maps for Penoyer, Tikaboo, Coal, Garden, Railroad, and the western part of the Snake valleys; all of these valleys are in Nevada (Figure 6-3). The dates these maps were completed are listed in Table 6-3.

6.2.2.2 <u>FY 81 Program</u>

No 1:62,500 scale topographic maps were produced in FY 81, however, the 1:9600 mapping did continue for two valleys in Nevada, one OB site in Nevada, and two OB sites in Utah. The two valleys were Hamlin and Lake and the OB sites were Coyote (Coyote Spring Valley, Nevada), Beryl, and Milford (Figure 6-3). The latter two OB sites are located in the Escalante

1: 62,500 SCALE TOPOGRAPHIC MAPS		
VALLEY	NUMBER OF MAP SHEETS	DATE MAP COMPLETED
PENOYER, NEV.	1	JULY 1980
TIKABOO, NEV.	1	JULY 1980
COAL, NEV.	1	OCTOBER 1980
GARDEN, NEV.	1	OCTOBER 1980
RAILROAD, NEV.	1	OCTOBER 1980
SNAKE (WESTERN), NEV.	1	DECEMBER 1980

1: 9600 SCALE TOPOGRAPHIC MAPS		
VALLEY/OB SITE	NUMBER OF MAP SHEETS	DATE MAPS COMPLETED
DRY LAKE, NEV.	37	SEPTEMBER 1979
DELAMAR & PAHROC	49	DECEMBER 1979
CAVE & MULESHOE	46	APRIL 1980
PINE, UTAH	55	AUGUST 1980
WAH WAH, UTAH	30	SEPTEMBER 1980
HAMLIN, NEV.	45	MAY 1981
LAKE, NEV.	72	AUGUST 1981
COYOTE OB, NEV.	5	JANUARY 1981
BERYL OB, UTAH	6	MARCH 1981
MILFORD OB, UTAH	18	MARCH 1981

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SUMMARY OF TOPOGRAPHIC MAPPING

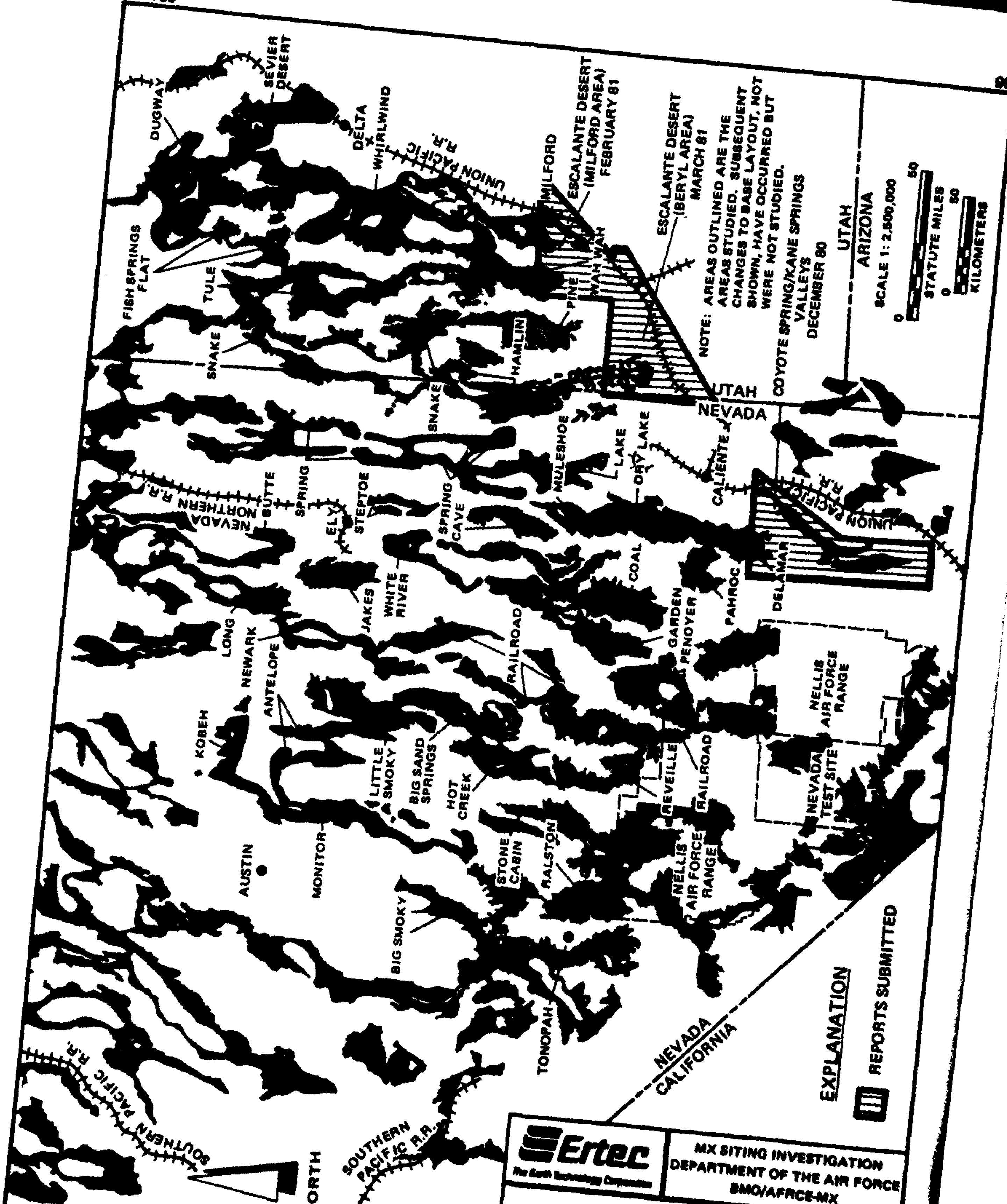
Desert, Utah. The number of map sheets and the dates the maps were completed are summarized in Table 6-3.

Topographic map coverage for the OB sites was based on preliminary OB siting studies performed by Ertec, the Air Force, and other associate contractors. Field control was extended beyond the initial OB siting areas in order to extend the topographic mapping quickly without having to perform additional field work. At the same time the mapping of the OB sites was in progress, the base comprehensive planner (EDAW) began studies to determine final OB site locations. These studies resulted in some changes in the boundaries of the original OB sites as depicted in the initial Land Acquisition Package which was submitted to the Air Force on 2 October 1981. As a result of the changes, the topographic maps that were originally produced for the three OB sites do not cover all portions of the final OB site layouts.

6.3 OPERATIONAL BASE STUDIES

6.3.1 Scope and Objectives

The candidate Operational Base sites at Milford, Coyote Spring, and Beryl (Figure 6-4) were evaluated to determine their geographic, cultural, geotechnical, and geohydrologic characteristics. Geographic and cultural data were compiled from BLM master title plats and available topographic maps. The geotechnical and geohydrological conditions were evaluated by detailed field mapping, subsurface exploration, interpretation of aerial photographs, and a review of existing literature.



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OPERATIONAL BASE STUDIES

6 NOV 81

FIGURE 6-4

In general, the studies were limited to evaluating the relative suitability of the areas as potential OB sites using subjective geotechnical criteria. Proposed options for Operational Base layouts were based on best estimates of the actual conditions on-site.

6.3.2 Siting Studies

At the outset of the siting studies, it was recognized that field investigation would be required before a final site could be selected. During the months of October and November 1980, preliminary geotechnical field studies were performed. The Operational Base field studies consisted of a combination of geologic, geophysical, geohydrological, and soils engineering investigative techniques designed to differentiate suitable and unsuitable areas and obtain basic information on soil and terrain characteristics. In addition, the field studies delineated areas subject to hazards such as flooding, faulting, subsidence, and rock fall. Following completion of the field studies, the data were compiled and three final reports (one for each proposed Operational Base) were submitted to the BMO/AFRCE between 23 December 1980 and 27 March 1981.

6.3.2.1 Layout Options

During Ertec's study of the Operational Base, activity centers within the base included 1) the Main Operating Base, 2) a Designated Assembly Area, 3) an operational base test and training site, 4) the support community (military), and 5) a marshalling yard. Each of the centers has a specified size

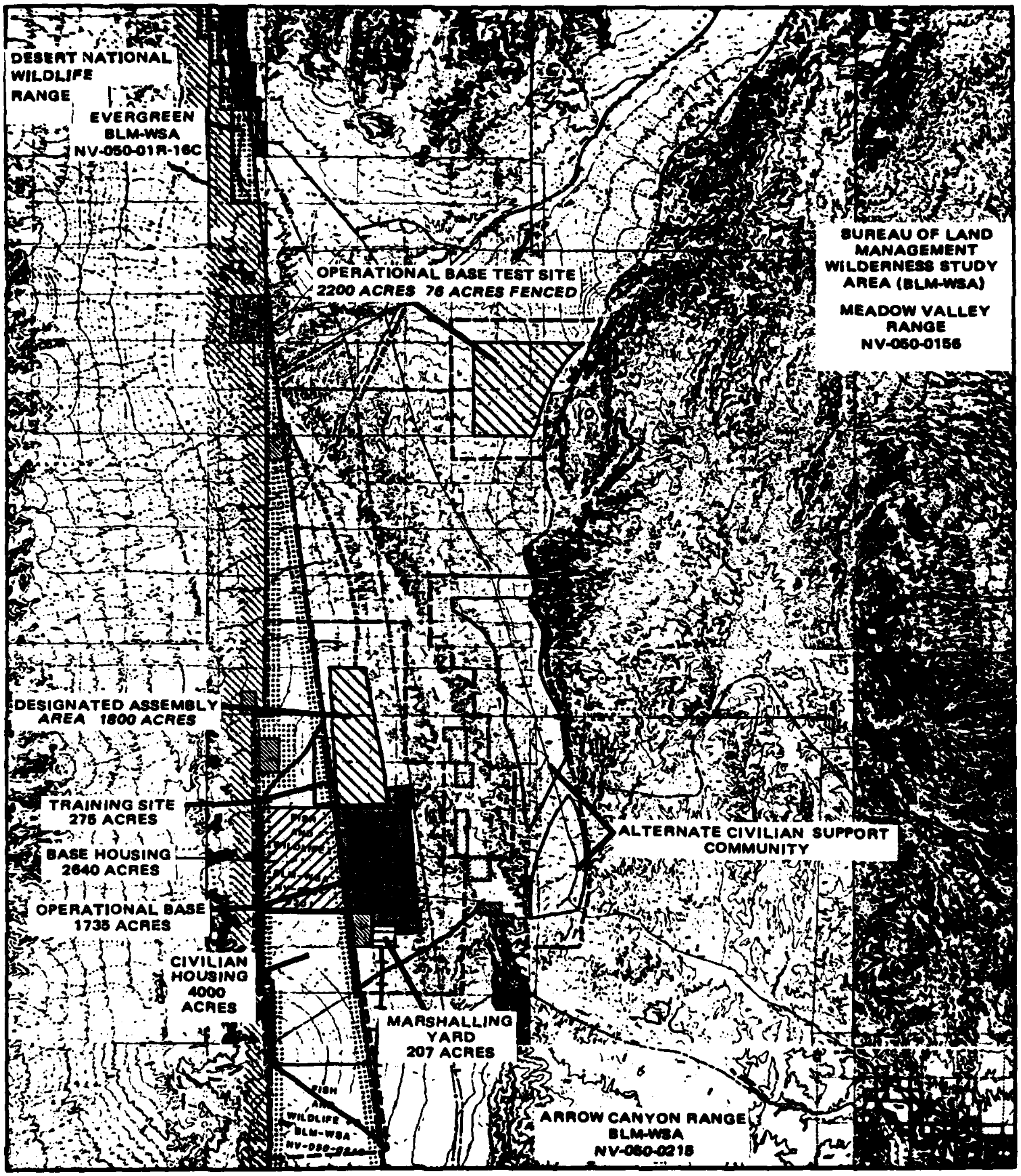
and, in some cases, a specified distance from other centers or structures.

Layout options for the three sites are shown in Figures 6-5 through 6-9. These layouts are responsive to the required area and separation distance specifications. The layouts represent an attempt to optimize the base siting to the geotechnical and cultural conditions in the siting areas. These studies were followed by more detailed studies by the base comprehensive planner (EDAW). From their studies, final sites were selected for the MOB, DAA, and support community. Ertec was tasked to carry out similar studies for the OBTSs after some revisions of the siting criteria. For these studies, geotechnical conditions were interpreted from aerial photographs; field verification studies were not performed.

6.4 OTHER STUDIES

6.4.1 Draft Environmental Impact Statement Responses

In May 1981, Ertec Western was authorized by AFRCE to participate in the response to public comments received on the Draft Environmental Impact Statement (DEIS) on deployment area selection and land withdrawal/acquisition for the MX system. The purpose of preparing these responses was to aid in updating the DEIS so that a Final Environmental Impact Statement (FEIS) could be prepared. Comments were received from Henningson, Durham and Richardson (HDR) through the Public Comment Management Information System (PCMIS). Final responses were composed for single and aggregated comments in the areas of geology, mining, and minerals.



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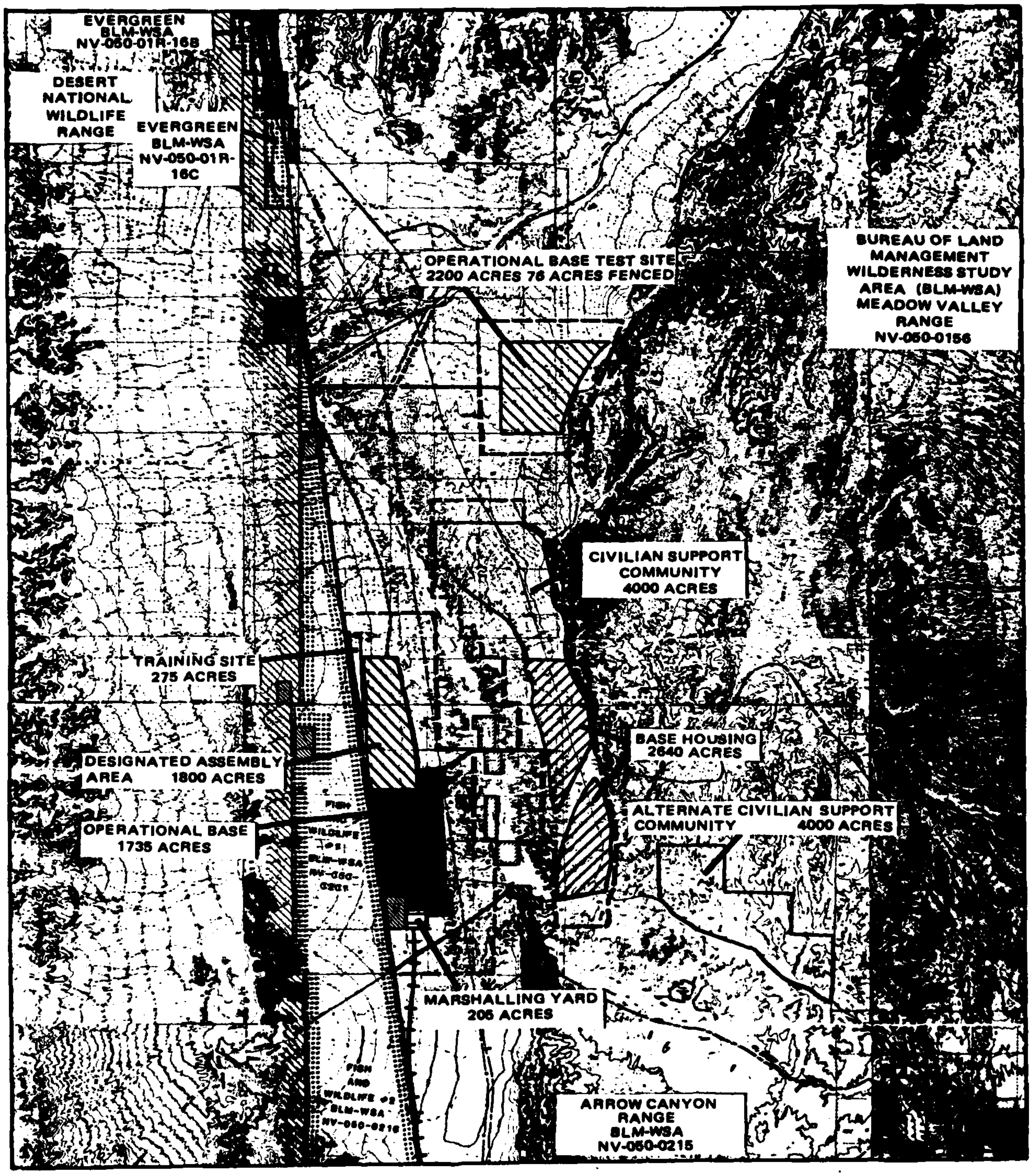
OPERATIONAL BASE LAYOUT
OPTION 1
COYOTE SPRING/KANE SPRINGS, NEVADA

6 NOV 81

FIGURE 6-8



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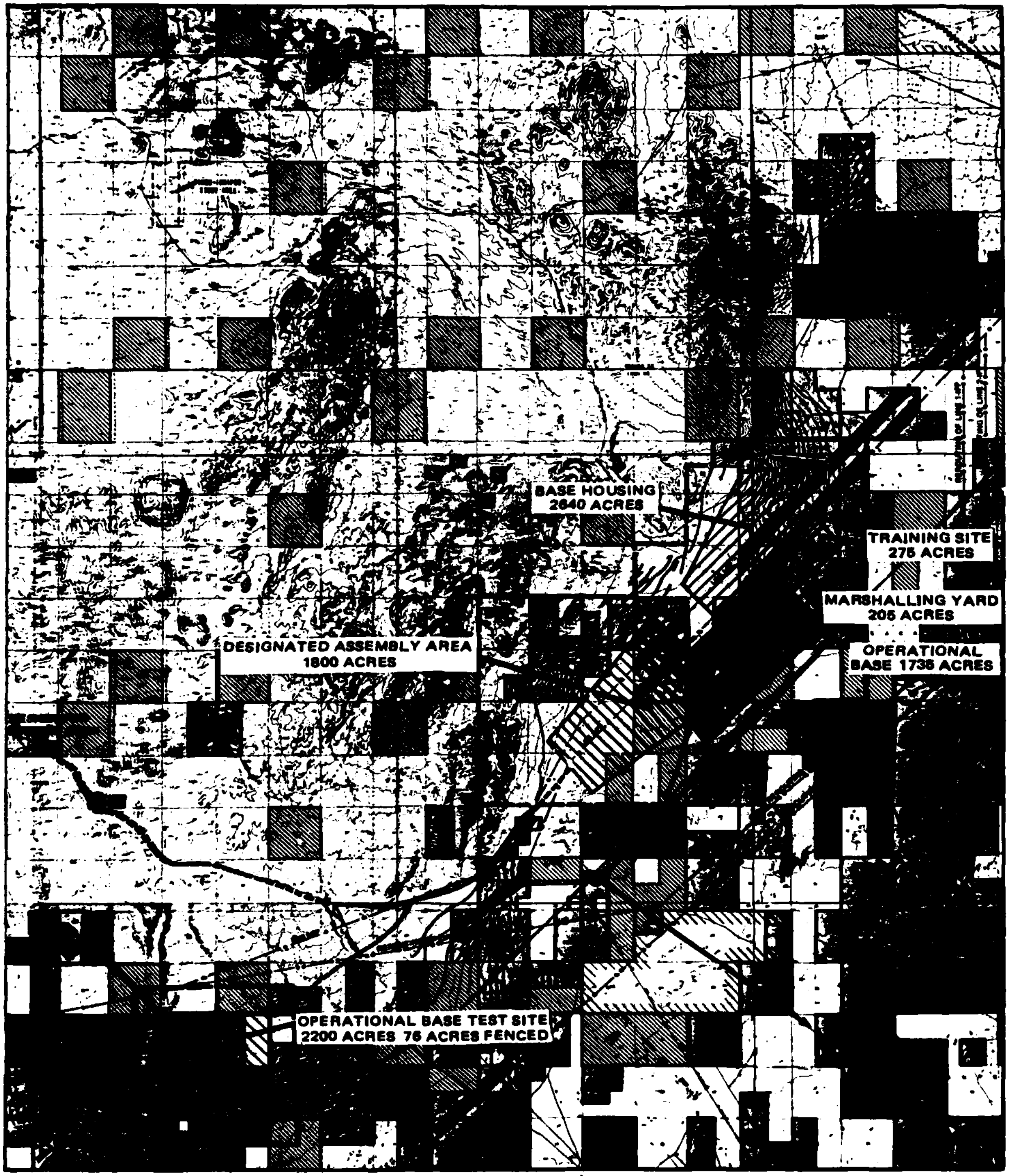
OPERATIONAL BASE LAYOUT
OPTION 2
COYOTE SPRING/KANE SPRINGS,
NEVADA

6 NOV 81

FIGURE 6-6



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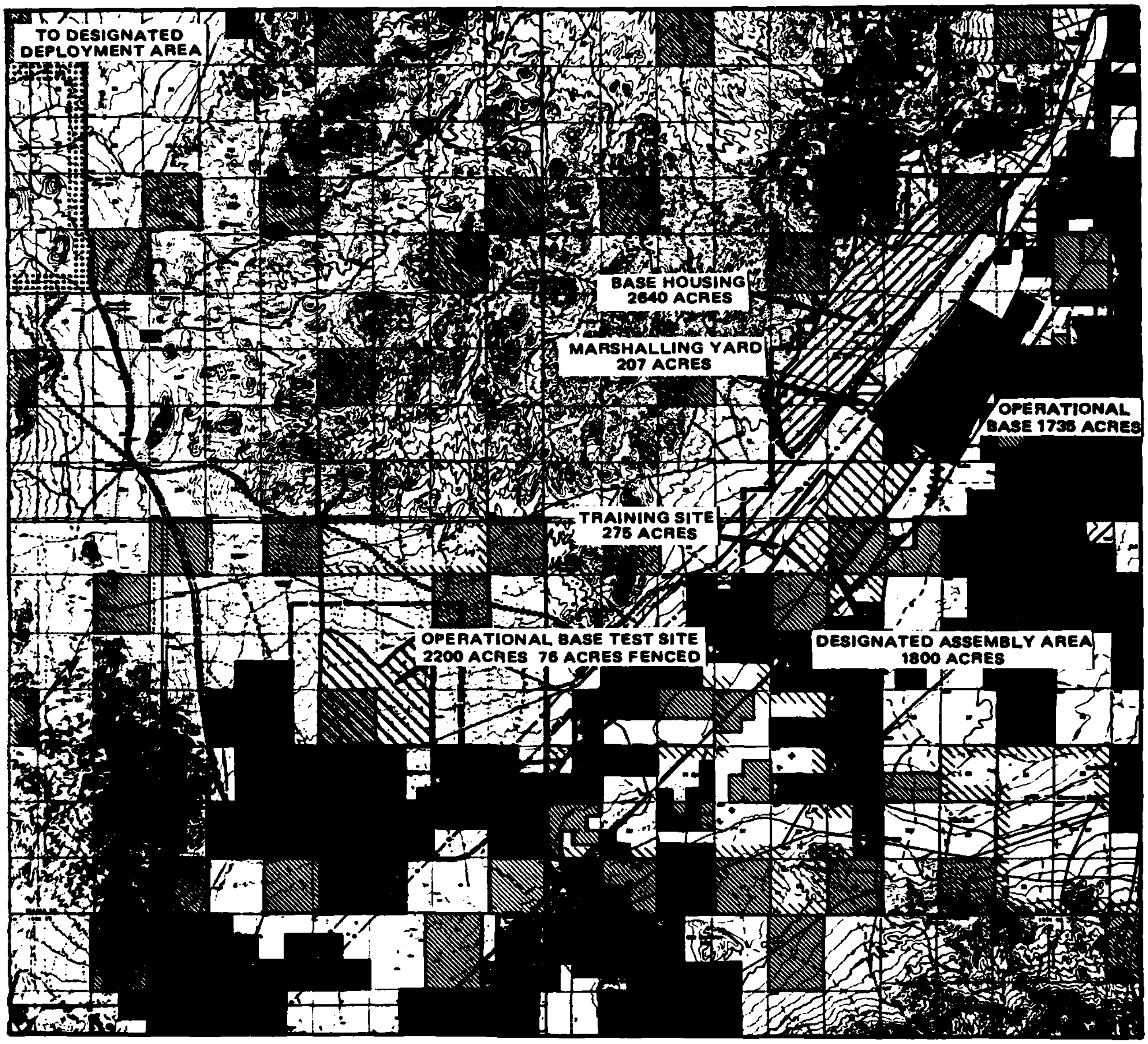
OPERATIONAL BASE LAYOUT
OPTION 1
ESCALANTE DESERT, MILFORD AREA,
UTAH

6 NOV 81 FIGURE 6-7



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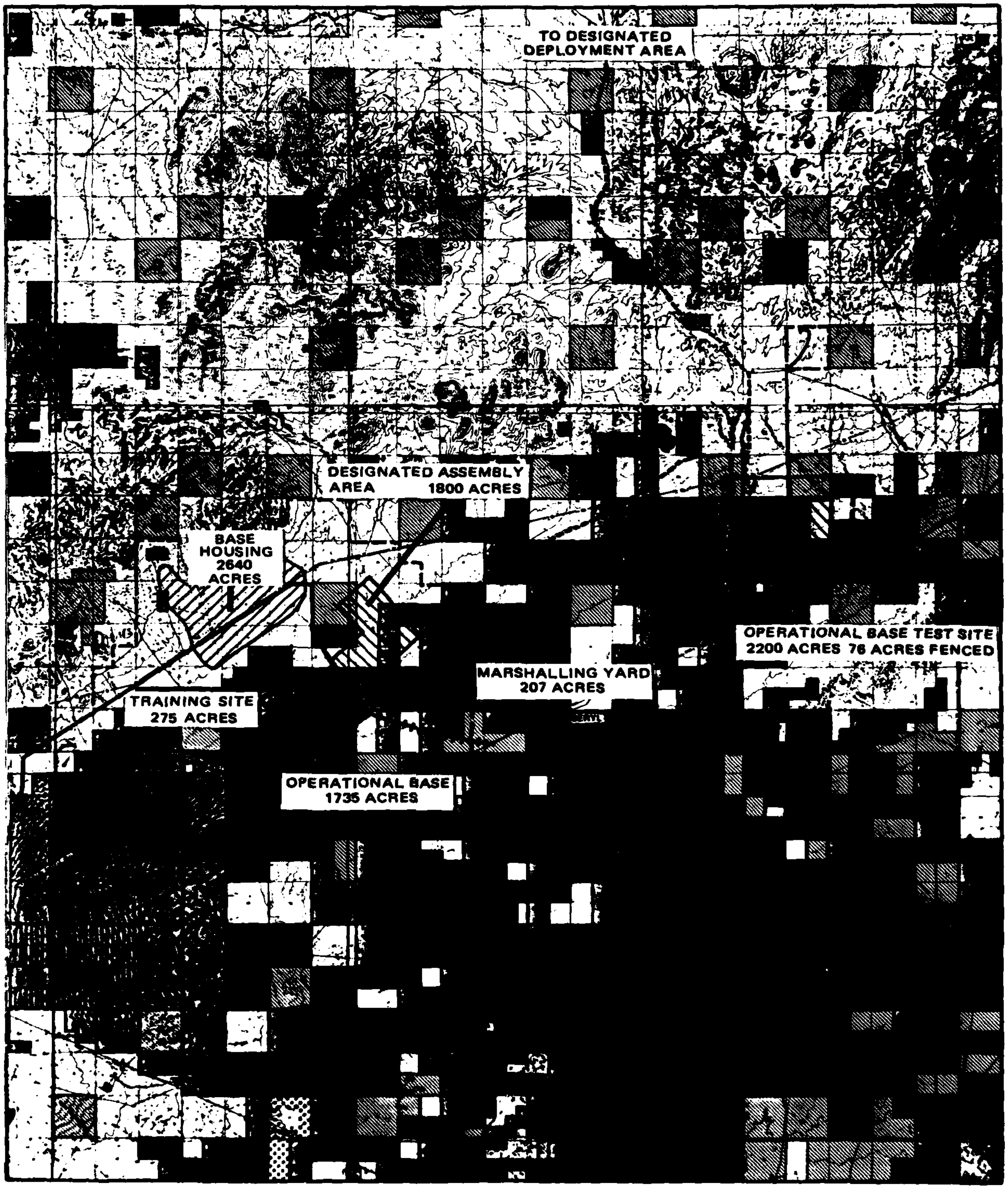
OPERATIONAL BASE LAYOUT
OPTION 2
ESCALANTE DESERT, MILFORD AREA,
UTAH

6 NOV 81

FIGURE 6-8



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MX SITING INVESTIGATION
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OPERATIONAL BASE LAYOUT
ESCALANTE DESERT,
BERYL AREA, UTAH

6 NOV 81

FIGURE 6-9

6.4.2 Road Design Methodology Studies

The road design methodology studies which began in FY 80 continued in FY 81. These studies consisted of:

1. Follow-on mobility tests;
2. CBR versus CPT correlation studies; and
3. Mechanistic approach to road design.

Brief summaries of work performed by Ertec pertaining to these studies are presented in the following paragraphs.

6.4.2.1 Follow-on Mobility Tests

In FY 81, four test beds were built at the Nevada Test Site for the follow-on mobility tests. These test beds consisted of a compacted subgrade with overlays of varying thicknesses of gravel, soil-asphalt, and soil-cement. The test beds were traversed by a Terex vehicle equipped with two different types of tires and wheel loads ranging from 60 kips to 115 kips. Ertec was involved in performing cone penetrometer tests in the test bed areas before compaction, before traffic (after compaction), and after traffic. The results were presented in a report in May 1981. Ertec was also involved in planning the test program, analyzing the test results, and recommending tire type, tire pressure, and wheel load for the prototype MX missile transporter.

6.4.2.2 CBR Versus CPT Correlation Studies

Field and laboratory studies were performed to develop correlation between California Bearing Ratio (CBR) and Cone

Penetrometer Test (CPT) resistance of the surficial soils from Nevada-Utah deployment area.

The field studies consisted of performing both CBR and CPTs at several locations in nine valleys in the deployment area. The laboratory studies were performed on four selected surficial soil samples from three valleys in the deployment area. These samples were compacted to four different densities in standard CBR molds for CBR tests and large molds (11.5 inches diameter and 14.5 inches high) for cone penetrometer tests. The studies resulted in developing preliminary relationships between CBR and CPT resistance. The results of these correlation studies were presented in a report in August 1981.

6.4.2.3 Mechanistic Approach to Road Design

The current state-of-art design methodology does not extend to roads subjected to very high wheel loads. Therefore, a mechanistic approach to the design of the operational roads was developed. In the mechanistic approach the stress-strain and failure properties of pavement and in-situ surficial soils were characterized by laboratory and field tests. The performance of selected pavement sections under different wheel loads was evaluated using numerical analyses. In order to perform the numerical analyses, DIRT II finite element program was used. This program was revised and modified to suit the characteristics of the surficial soils and boundary conditions of the wheel loading configuration. The results of Ertec's studies were presented in two briefings to the Roads Working Group in

March and May 1981. In addition, the mechanistic approach was used to predict the behavior of the test roads, under traffic, of the Follow-on Mobility Tests conducted at Nevada Test site. The predictions were in good agreement with the field results. The mechanistic design approach was also used to estimate the behavior of the operational roads in Nevada-Utah under the wheel loads of the MX missile transporter.

6.4.3 Site Selection Study for Multifrequency Resistivity Tests

A study was made of existing gravity, seismic refraction, and electrical resistivity data in the proposed MX siting region to select test sites for multi-frequency (to 100 kHz) resistivity studies to be conducted by Mission Research Co. and the U.S. Geological Survey. The purpose of their studies was to evaluate the levels of currents which would be induced from the electromagnetic pulse that accompanies an atmospheric nuclear explosion. In order to evaluate the geological influence on the multifrequency measurements, a program of conventional deep electrical soundings by Ertec was planned, and Letter of Authorization requests for land access have been submitted to the Corps of Engineers.

APPENDIX A

TECHNICAL REPORT LIST

TR REPORTS WITH NUMBER DESIGNATIONS

Report Number	Description	Date of Report
FN-TR-1	Fugro National, Inc., 1975a, Siting evaluation report: Cons. report for SAMSO, v. I,55 p., appendices.	30 June 1975
FN-TR-2	__________, 1975b, Geotechnical report, White Sands Missile Range/Fort Bliss Military Reservation: Cons. report for SAMSO, v. IIA, 113 p., data summary sheets, appendices and graphics volume.	30 June 1975
FN-TR-3	__________, 1975c, Geotechnical report, Yuma Proving Grounds/ Luke-Williams Bombing and Gunnery Range: Cons. report for SAMSO, v. IIB, 122p., data summary sheets, appendices and graphics volume.	30 June 1975
FN-TR-4	__________, 1975d, Geotechnical report, Nellis Bombing and Gunnery Range: Cons. report for SAMSO, v. IIC, 125 p., data summary sheets, appendices and graphics volume.	30 June 1975
FN-TR-5	__________, 1975e, Recommended geotechnical field investigation: Cons. report for SAMSO, v. III, 45 p.	30 June 1975
FN-TR-6	__________, 1975f, Environmental assessment report: Geotechnical field investigation: Cons. report for SAMSO, v. IV, 165 p., appendices.	30 June 1975
FN-TR-7	__________, 1975g, Water rights and resources: Cons. report for SAMSO, 104 p., appendices.	30 November 1975
FN-TR-8	__________, 1975, Comparative environmental assessment of the three MX land mobile missile system concepts: Cons. report for SAMSO, 179 p., appendices.	30 November 1975
FN-TR-9	__________, 1976a, Siting evaluation report: Cons. report for SAMSO, v. I, 63 p., appendices.	31 May 1976

TR REPORTS WITH NUMBER DESIGNATIONS (cont.)

Report Number	Description	Date of Report
FN-TR-10	__________, 1976b, Geotechnical report, White Sands Missile Range Extension: Cons. report for SAMSO, v. IIA, 88p., data summary sheets, appendices and graphics volumes.	31 May 1976
FN-TR-11	__________, 1976c, Geotechnical report, Gila Bend Group: Cons. report for SAMSO, v. IIB, 120 p., data summary sheets, appendices and graphics volume.	31 May 1976
FN-TR-12	__________, 1976d, Geotechnical report, Nellis Group: Cons. report for SAMSO, v. IIC, 142 p., data summary sheets, appendices and graphics volume.	31 May 1976
FN-TR-13	__________, Inc., 1976e, Recommended geotechnical field investigations: Cons. report for SAMSO, v. III, 79 p., appendix.	31 May 1976
FN-TR-14	__________, 1976f, Multiple aim-point validation (MAV) program, Luke Bombing and Gunnery Range, Arizona. Part 1 - Site selection and surficial geology, Part 2 - Soils engineering and seismic refraction: Cons. report for SAMSO, 63 p.	30 September 1976
FN-TR-15	__________, 1976g, MX siting regions evaluations: Delineation and analysis of suitable Department of Defense and Bureau of Land Management lands: Cons. report for SAMSO, 51 p., appendices.	30 September 1976
FN-TR-16	__________, 1977a, MX siting investigation conterminous United States, volume I coarse screening: Cons. report for SAMSO, v. I, 30 p., app.	1 June 1977
FN-TR-17	__________, 1977b, MX siting investigation geotechnical evaluation conterminous United States, volume II intermediate screening: Cons. report for SAMSO, v. II, 175 p., appendices.	30 September 1977

TR REPORTS WITH NUMBER DESIGNATIONS (cont.)

Report Number	Description	Date of Report
FN-TR-18	Fugro National, 1977d, Geotechnical report Mohawk - Tule Valley, Arizona: cons. report for SAMSO, v. I and II, 141 p., appendices.	Vol. I - 27 January 1978 Vol. II - 17 September 1977
FN-TR-19	__________, 1978a, Geotechnical report Lechuguilla Desert Arizona; cons. report for SAMSO, v. I and II, 147 p., appendices.	20 January 1978
FN-TR-20	__________, 1978c, Aggregate Resources Report Department of Defense and Bureau of Land Management lands, southwestern United States: Cons. report for SAMSO, 74 p., appendices. (draft).	10 February 1978
FN-TR-21	__________, 1978d, Geotechnical Investigation Misers Bluff Test Program Planet Ranch Test Valley, Arizona: Cons. report for SAMSO, 52 p., appendices. (draft).	23 September 1977
FN-TR-21A	__________, 1978, Crosshole velocity survey, Misers Bluff ground zero-2 (GZ-2) Planet Ranch Test Valley, Arizona.	20 March 1978
FN-TR-22	__________, 1978e, MX siting investigation, geotechnical evaluation, Trench Layout Report: Cons. report for SAMSO, 39 p., appendices. (draft).	31 March 1978
FN-TR-23	__________, 1978f, Geotechnical investigation, Methodology Report, MX siting investigation, western conterminous United States: Cons. report for SAMSO, 67 p., appendices (draft).	30 March 1978
FN-TR-24	__________, 1978g, MX siting investigation, conterminous United States, V. III Fine Screening: Cons. Report for SAMSO. (in progress).	14 July 1978 revised - 11 September 1978
FN-TR-25	__________, 1978h, MX siting investigation, geotechnical evaluation, Geotechnical Ranking of Seven Candidate Siting Regions Report.	30 May 1979

TR REPORTS WITH NUMBER DESIGNATIONS (cont.)

Report Number	Description	Date of Report
FN-TR-26a	Fugro National, 1978i, MX siting investigation, geotechnical summary, prime characterization sites, Central High Plains Candidate Siting Province Report.	16 June 1978
FN-TR-26b	__________, 1978j, MX siting investigation, geotechnical summary, prime characterization sites, Southern High Plains Candidate Siting Province Report.	29 September 1978 revised - 2 February 1979
FN-TR-26c	__________, 1978k, MX siting investigation, geotechnical summary, prime characterization sites, Rio Grande/Highlands Candidate Siting Province Report.	16 June 1978
FN-TR-26d	__________, 1978l, MX siting investigation, geotechnical summary, prime characterization sites, Sonoran Candidate Siting Province Report.	16 June 1978
FN-TR-26e	__________, 1978m, MX siting investigation, geotechnical summary, prime characterization sites, Great Basin Candidate Siting Province Report.	16 June 1978
FN-TR-27	Verification Reports (see Sheet A)	
FN-TR-28	Fugro National, 1979b, Arizona Verification Studies, FY 79: Cons. report for SAMSO; v. I, ___ pages and one data volume with 13 tables, 17 figures, 13 drawings, 95 p., and appendices; v. II, data volume similar to v. I.	5 November 1979
FN-TR-29	__________, 1979c, Thermal Properties of Soils, 137 pages, 59 figures, 9 tables, and 13 plates.	23 November 1979
FN-TR-30	__________, 1979d, Executive Summary Report, Geotechnical siting investigation FY 79, 74 p., 20 figures, 6 tables, 5 photographs.	26 October 1979
FN-TR-31	__________, 1979f, Alternative Energy Sources for the MX System, Nevada-Utah (Draft); 520 p.; 24 figures.	draft - 25 February 1980 30 April 1980

TR REPORTS WITH NUMBER DESIGNATIONS (cont.)

Report Number	Description	Date of Report
FN-TR-32	Fugro National, 1980d, MX Siting Investigation, Shelter Layout Study; 30 p.; 1 figure; 8 tables; 7 drawings.	27 February 1980
FN-TR-33	Gravity Survey Reports (see Sheet B)	
FN-TR-34	Fugro National, Inc., 1980f, Aggregate Resources Report, Utah-Nevada Study Area, 99 p., 3 figures; 35 tables; 6 photos; 2 drawings.	3 March 1980
FN-TR-35	__________, 1980c, (1) Proposed Operational Base Site, Coyote Spring and Kane Springs Valleys, Nevada; 41 p.; 7 figures; 2 tables; 3 drawings. (2) Proposed Operational Base Site, Escalante Desert, Milford Area, Utah; 39 p.; 7 figures; 3 tables; 3 drawings. (3) Proposed Operational Base Site, Steptoe Valley, Ely Area, Nevada; 38 p.; 5 figures; 3 tables; 3 drawings.	15 May 1980
FN-TR-36	__________, 1980i, Interim Report on Active Faults and Earthquake Hazards in the FY 79 Verification Sites - Nevada-Utah Siting Region; 72 p.; 2 figures; 5 drawings.	26 March 1980
FN-TR-37	Aggregate Resources Reports - Valley Specific (see Sheet C)	
FN-TR-38	Fugro National, 1980l, EIS Water Resources Program Summary for Draft Environmental Impact Statement, Vol. I, 151 p., 4 figures, 6 tables; Water Resources Program Summary for Draft Environmental Impact Statement, Vol. II, 8 tables.	15 May 1980 revised - 1 August 1980
FN-TR-39	__________, 1980r, Summary of Suitable Area, Nevada-Utah, verification studies, FY 79 and FY 80, v. I; 12 p., 4 tables, 13 drawings; Summary of suitable area Nevada-Utah, verification studies, FY 79 and FY 80, v. II; 7 drawings.	2 July 1980
FN-TR-40	__________, 1980t, MX siting investigation, water resources program interim report; 94 p., 3 figs., 5 tables, 9 app.	31 October 1980

TR REPORTS WITH NUMBER DESIGNATIONS (cont.)

Report Number	Description	Date of Report
FN-TR-41	Fugro National, 1980u, MX Mineral resources survey, Nevada/Utah siting area (draft), v. I-XI, 311 p., 3 app.	30 October 1980 revised - 15 January 1981
FN-TR-42	__________, 1980, Executive Summary, FY 80 Geotechnical Study, 1980, 103 pp., 1 app., 33 figs., 12 tables, 7 drawings.	30 November 1980
FN-TR-43	__________, 1981a, Preliminary Geotechnical Investigation, Proposed Operational Base Site, Coyote Spring Valley, Nevada, v. I and II.	23 December 1980
FN-TR-44	__________, 1980, Preliminary Geotechnical Investigation Proposed OB site, Milford Utah, 77 pp. vol. I Synthesis, 12 figs., 7 tables, 6 drawings. 203 pp., vol. II, Geotechnical data, 131 figs., 6 tables, 1 drawing.	20 February 1981
FN-TR-45	__________, 1981i, Preliminary Geotechnical Investigation Proposed OB Site, Beryl, Utah, vol. I Synthesis, 66 pp., 4 app., 7 figs., 6 tables, 6 drawings.	27 March 1981
FN-TR-46	__________, 1981h, Preliminary Biological and Cultural Resources Inventory and Environmental Evaluation of the Proposed Operational Base Sites in Coyote Spring Valley and Milford-Beryl area, 1981h, 168 pp., 4 app., 25 figs., 17 tables, 4 Eq.	20 March 1981
E-TR-47	Ertec Western, Aggregate Resources Reports - Valley Detailed (see Sheet D)	
E-TR-48-I	__________, 1981t, Program Overview and Methodology, Field Surveys, IOC Valleys, 94 pp., 3app., 19 figs., 1 drawing.	8 July 1981 revised - August 1981
E-TR-48-II-I	__________, 1981t, Field Surveys, IOC Valleys, Biological Resources Survey, Dry Lake Valley, Nevada, vol. II, part I 251 pp., 9 app., 50 figs., 48 tables.	August 1981

TR REPORTS WITH NUMBER DESIGNATIONS (cont.)

Report Number	Description	Date of Report
E-TR-48-II-II	________, 1981t, Field Surveys, IOC Valleys, Biological Resources Survey, Pine and Wah Wah valleys, Utah, vol. II, part II, 288 pp., 10 app., 66 figs., 5 tables.	August 1981
E-TR-48-III-I	________, 1981t, Field Surveys, IOC Valleys, Cultural Resources Survey, Dry Lake Valley, Nevada, vol. III, part I, 169 pp., 9 app., 17 figs., 19 tables.	August 1981
E-TR-48-III-II	________, 1981t, Field Surveys, IOC Valleys, Cultural Resources Survey, Pine and Wah Wah valleys, Utah, vol. III, part II, 133 pp., 5 app., 18 figs., 22 tables.	August 1981
E-TR-49-II	Ertec Western, 1981u, Mineral Resources Survey, Operational Base Sites, Nevada/Utah Siting Area, vol. I, vol. II, and vol. III, 30 April 1981, 75 pp., 2 figs., 8 photos, 5 app., 12 drawings.	Not submitted (1)
E-TR-50	________, 1981v, Mineral Resources Survey, Seven Additional Valleys, Nevada/Utah Siting Area, 23 June 1981, vol. I, II, III, IV, maps and appendices.	22 June 1981
E-TR-51	________, 1981w, Water Resources Operational Base Studies Report. Vol. I, Coyote Spring Operational Base, Nevada, 57 pp., 6 app., 12 figs., 13 tables. Vol. II, Milford and Beryl Operational Bases, Escalante Valley, Utah, 82 pp., 7 app., 19 figs., 16 tables, 2 drawings.	28 May 1981

(1) The report was not submitted because there were some changes in the locations of the operational base sites. The report was to be submitted after the surveys were extended to the new locations.

TR REPORTS WITH NUMBER DESIGNATIONS (cont.)

Report Number	Description	Date of Report
E-TR-52	__________, 1981y, Water Resources Program Technical Summary Report, 1981s. Vol. I, 97 pp., 5 figs., 2 app., 2 drawings, 55 tables. Vol. II, 286 pp., 4 tables. Vol. IIA, 41 pp., 38 figs. Vol. IIB, 146 pp., 111 tables.	In Progress
E-TR-53	__________, 1981, Water Resources Program, Preliminary Water Management Report vol. I, 250 pp., 1 app., 5 figs., 57 drawings. Vol. II, 13 drawings.	28 September 1981
E-TR-54	__________, 1981, Faults and Lineaments in the MX Siting Region, Nevada and Utah. Vol. I, 77 pp., 11 figs., 3 tables. Vol. II, 3 tables, 1 fig., 11 plates.	6 November 1981
E-TR-56	__________, 1981, Assessment of Aquifer Impacts of MX Groundwater Withdrawals, Dry Lake Valley, Nevada, 36 pp., 4 figs., 6 tables.	30 November 1981
E-TR-58	__________, 1981, MX-System Siting Summary, Part I, Shelter Siting Summary, 17 pp., 18 drawings. Part II, 282 pp., 57 tables, 23 figs. Part III, 344 pp., 25 tables, 15 figs.	In Progress
E-TR-59(1)	__________, 1981, DTN/OBTS Field Surveys.	In Progress
E-TR-60	__________, 1981, Mechanistic Approach to MX Road Design Methodology.	In Progress

(1) As directed by a Stop Work Order, this report was not completed.

VERIFICATION REPORTS

Report Number	Description	Date of Report
FN-TR-27	Fugro National, 1979a, Nevada-Utah Verification Studies, FY 79: Cons. report for SAMSO; v. IA 221 pages, v. I (B 122 pages appendix; v. 2 through 8, data volumes with about 15 tables, 75 figures, and 4 drawings in each volume.	Vol. I & II 17 - July 1979 Vol. III - VIII and 1A & 1B - 24 August 1979
FN-TR-27-DL	__________, 1980g, Verification Study, Dry Lake Valley, Nevada; v. I - Synthesis, 90 .; 11 figures; 11 tables; 7 drawings; v. II - Geotechnical Data; 28 p.; 86 figures; 21 tables; 6 drawings.	14 March 1980
E-TR-27-RV (1)	__________, 1980, Verification Study, Ralston Valley, Nevada, 1981k, Vol. I, Synthesis, 48 pp., 5 app., 12 figs., 11 tables, 7 drawings. Vol. II Geotechnical Data, 23 pp., 16 figs., 62 tables, 1 drawings.	15 June 1980
FN-TR-27-DM	__________, 1981i, Verification Study, Delamar Valley, Nevada, 1981k, Vol. I, Synthesis, 48 pp., 5 app., 12 figs., 11 tables, 7 drawings. Vol. II Geotechnical data, 97 pp., 53 figs., 10 tables, 2 drawings.	24 March 1981
FN-TR-27-WA	__________, 1981k, Verification Study, Wah Wah Valley, 1981m, Vol. I Synthesis, 46 pp., 9 figs., 8 tables, 7 drawings. Vol. II Geotechnical data, 149 pp., 83 figs., 15 tables, 2 drawings.	24 March 1981

(1) The Verification studies in Ralston Valley did not include cone penetrometer tests, test pits, surficial samples, or resistivity surveys.

VERIFICATION REPORTS

Report Number	Description	Date of Report
FN-TR-27-PI	__________, 19811, Verification Study, Pine Valley, Utah, 1981n, Vol. I Synthesis, March 24, 1981, 48 pp., 5 app., 12 figs., 10 tables, 7 drawings. Vol. II Geotechnical data, 161 pp., 88 figs., 9 tables, 2 drawings.	24 March 1981
E-TR-27-PA	__________, 1981, Verification Study, Pahroc Valley, Nevada, Vol. I, Synthesis, 30 June 1981, 49 pp., 6 app., 8 figs., 11 tables, 7 drawings. Vol. II, Geotechnical Data, 84 pp., 35 figs., 8 tables, 1 drawing.	30 June 1981
E-TR-27-MS	__________, 1981, Verification Study, 1981, Muleshoe Valley, Nevada, Vol. I, Synthesis, 30 June 1981, 50 pp., 5 app., 11 figs., 10 tables, 7 drawings. Vol. II, Geotechnical Data, 92 pp., 41 figs., 10 tables, 1 drawing.	30 June 1981
E-TR-27-LV	__________, 1981, Verification Study, Lake Valley, Nevada, Vol. I, Synthesis, 58 pp., 5 app., 16 figs., 10 tables., 9 drawings. Vol. II, Geotechnical Data, 197 pp., 89 figs., 11 tables, 1 drawings.	31 July 1981
E-TR-27-CV	__________, 1981, Verification Study, Cave Valley, Nevada Vol. I Synthesis, 26 October 1981, 99 p., 15 figs., 10 tables, 7 drawings. Vol. II Geotechnical data, 97 p., 43 figs., 10 tables, 1 drawing.	26 October 1981

GRAVITY SURVEY REPORTS

Report Number	Description	Date of Report
FN-TR-33-WW	Fugro National, 1980a, Gravity Survey - Whirlwind Valley, Utah, 19 p., 2 app., 8 figs.	30 January 1980
FN-TR-33-HV	___________, 1980b, Gravity Survey - Hamlin Valley, Nevada; 16 p., 2 app., 13 figs.	27 February 1980
FN-TR-33-DL	___________, 1980h, Gravity Survey - Dry Lake Valley, Nevada; 18 p., 2 app., 7 figs.	27 March 1980
FN-TR-33-SV	___________, 1980j, Gravity Survey - Southern Snake Valley (Ferguson Desert), Utah; 13 p., 2 app., 11 figs.	28 March 1980
FN-TR-33-WR	___________, 1980m, Gravity Survey - Southern White River Valley, Nevada; 23 p., 2 app., 8 figs., 1 table, 1 drawing.	22 May 1980
FN-TR-33-GN	___________, 1980n, Gravity Survey - Garden Valley, Nevada, 14 p., 2 app., 6 figs., 1 drawing.	30 May 1980
FN-TR-33-CL	___________, 1980o, Gravity Survey - Coal Valley, Nevada, 13 p., 2 app., 6 figs., 1 drawings.	30 May 1980
FN-TR-33-BG	___________, 1980p, Gravity Survey - Big Sand Springs Valley, Nevada, 17 p., 1 app., 5 figs.	09 July 1980
FN-TR-33-HC	___________, 1980q, Gravity Survey - Hot Creek Valley, Nevada, 18 p., 1 app., 5 figs.	09 July 1980
FN-TR-33-BS	___________, 1980r, Gravity Survey - Big Smoky Valley, Nevada, 15 p., 1 app., 2 figs., 1 table, 2 drawings.	28 November 1980
E-TR-33-WA	Ertec Western, Gravity Survey, Wah Wah Valley, Utah, 17 p., 2 app., 3 figs., 2 tables, 2 drawings.	2 March 1981

GRAVITY SURVEY REPORTS

Report Number	Description	Date of Report
E-TR-33-PI	___________, Inc., 1981h, Gravity Survey, Pine Valley, Utah, 1981p, 19 p., 2 app., 5 figs., 2 tables, 2 drawings.	2 March 1981 revised - 15 May 1981
E-TR-33-LV	___________, Inc., 1981, Gravity Survey, Lake Valley, Nevada, 17 p., 2 app., 2 figs., 2 drawings.	20 May 1981
E-TR-33-SP	___________, Inc., 1981, Gravity Survey, Spring Valley, Nevada, 13 p., 2 app., 1 fig., 2 drawings.	20 May 1981
E-TR-33-DM	___________, Inc., 1981, Gravity Survey, Delamar Valley, Nevada, 16 p., 1 app., 2 figs., 2 drawings.	20 July 1981
E-TR-33-PA	___________, Inc., 1981, Gravity Survey, Pahroc Valley, Nevada, 19 p., 2 app., 3 figs., 2 tables, 2 drawings.	20 July 1981
E-TR-33-RV	___________, Inc., 1981, Gravity Survey, Ralston Valley, Nevada, 19 p., 2 app., 4 figs., 2 drawings.	20 August 1981
E-TR-33-DW	___________, Inc., 1981, Gravity Survey, Dugway Valley, Utah, 1981, 21 p., 2 app., 5 figs., 1 table, 2 drawings.	19 December 1981 revised - 28 August 1981
E-TR-33-SD	___________, Inc., 1981, Gravity Survey, Sevier Desert Valley, Utah, 1981, 16 p., 2 app., 2 figs., 2 drawings.	24 January 1981 revised - 28 August 1981
E-TR-33-MS	___________, Inc., 1981, Gravity Survey, Muleshoe Valley, Nevada, 20 p., 2 app., 6 figs., 2 drawings.	14 September 1981
E-TR-33-CV	___________, Inc., 1981, Gravity Survey, Cave Valley, Nevada, 20 p., 3 app., 4 figs., 2 drawings.	14 September 1981

AGGREGATE RESOURCES REPORT - VALLEY SPECIFIC

Report Number	Description	Date of Report
FN-TR-37	Fugro National, 1980k, Valley-Specific Aggregate Study.	6 June 1980
a to e	a. Dry Lake, Muleshoe, Delamar, Pahroc Valleys; 45 p.; 6 figures; 3 tables; 2 drawings.	
	b. Snake Valley, 47 p.; 9 figures, 3 tables; 2 drawings.	
	c. White River Valley; 44 p.; 7 figures; 3 tables 2 drawings.	
	d. Whirlwind Valley, 43 p.; 5 figures; 3 tables; 2 drawings.	
	e. Hamlin Valley; 44 p.; 6 figures; 3 tables; 2 drawings.	
FN-TR-37-g	__________, 1981b, Aggregate Resources Study, 1981, Pine, Wah Wah, Utah 42 pp., 1 app., 2 tables, 2 figs., 2 drawings.	27 February 1981
FN-TR-37-f	__________, 1981c, Aggregate Resources Study, Lake Valley, 1981d 40 pp., 1 app., 2 tables, 2 figs., 2 drawings.	27 February 1981
E-TR-37-i	__________, 1981, Aggregate Resources Study, Garden and Coal valleys, Nevada, 43 pp., 5 app., 2 figs., 2 tables, 2 drawings.	2 July 1981
E-TR-37-h	__________, 1981, Aggregate Resources Study, Tule Valley, Nevada, 41 pp., 5 app., 2 figs., 2 tables, 2 drawings.	3 July 1981
E-TR-37-j	__________, 1981, Aggregate Resources Study, Cave and Steptoe valleys, Nevada, 41 pp., 5 apps., 2 figs., 2 tables, 2 drawings.	25 September 1981

AGGREGATE RESOURCES REPORT - VALLEY DETAILED

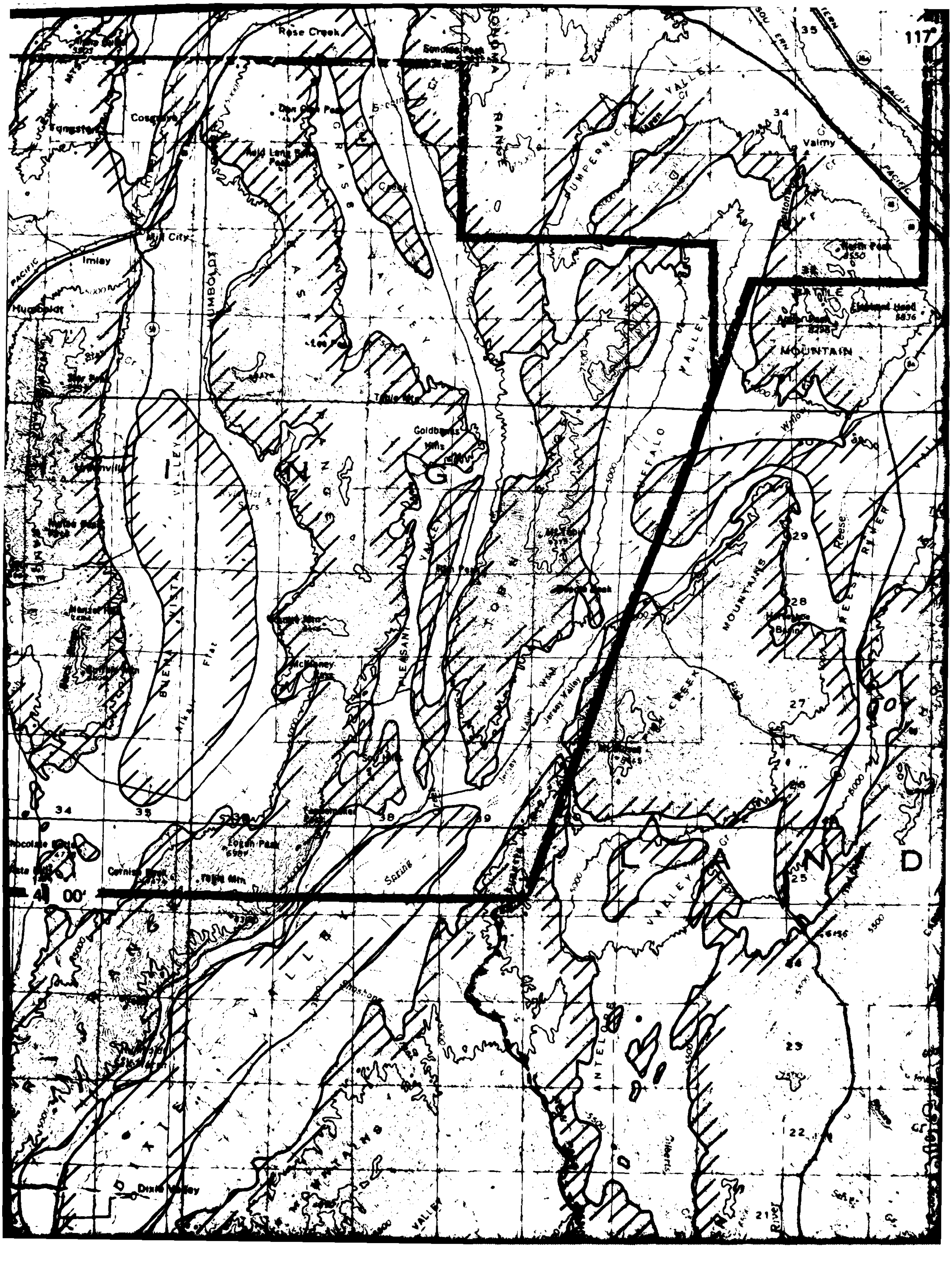
Report Number	Description	Date of Report
E-TR-47-PI	Ertec Western, 1981o, Detailed Aggregate Resources Study, Pine Valley, Nevada, 12 June, 1981, 75 pp. 7 appendixes, 7 figs., 6 tables, 3 drawings.	21 June 1981
E-TR-47-WW	__________, 1981p, Detailed Aggregate Resources Study, Wah Wah Valley, Utah, 12 June 1981, 86 pp. 7 app., 9 figs., 7 tables, 3 drawings.	21 June 1981
E-TR-47-DM	__________, 1981q, Detailed Aggregate Resource Study, Delamar Valley, Nevada, 29 May 1981, 58 pp., 7 app., 3 tables, 6 figs., 3 drawings.	29 May 1981
E-TR-47-DL	__________, 1981, Detailed Aggregate Resource Study, Dry Lake Study Area, Nevada, 29 May 1981, 80 pp., 7 apps., 9 figs., 7 tables, 3 drawings.	29 May 1981
E-TR-47-MS	__________, 1981r, Detailed Aggregate Resource Study, Muleshoe Valley, Nevada, 5 June, 1981, 54 pp., 7 app., 5 figs., 5 tables, 3 drawings.	5 June 1981
E-TR-47-PA	__________, 1981s, Detailed Aggregate Resource Study Pahroc Study Area, Nevada, 5 June 1981, 59 pp., 7 app., 6 figs., 3 tables, 3 drawings.	5 June 1981

TR REPORTS WITH LETTER DESIGNATIONS

Report Number	Description	Date of Report
FN-TR-ST	Fugro National, 1977c, MX siting program soil temperature determination, Luke Bombing and Gunnery Range, Arizona: Cons. report for SAMSO, in progress, 32 p., appendices.	31 May 1977
FN-TR-WR	__________, 1977e, Evaluation of water resources in vicinity of Stoval Field, San Cristobal Valley, Yuma county, Arizona: cons. report for SAMSO, 42 p., appendices.	October 1977
FN-TR-GE	__________, 1978b, General geotechnical site feasibility analysis for the environmental assessment of an MX test facility, Vandenberg Air Force Base, California: Cons. Report for SAMSO, 29 p., appendices.	1 January 1978
FN-TR-BT	__________, 1978N, Geotechnical report, shear strength of compacted backfill, break-out and erection tests, MAV test site, San Cristobal Valley, Arizona, 51 p.	23 October 1978
FN-TR-RP	__________, 1979e, Railroad Pass Evaluation, Nevada-Utah Siting Area, 21 p., 2 figures, 1 table, 3 photos, 2 drawings.	16 November 1979
FN-TR-WS	__________, 1980e, Evaluation of Screening Results and Geotechnical Conditions, State of Wyoming; 26 p.; 6 figures; 1 table.	28 February 1980
FN-TR-DTN	__________, 1980p, Preliminary evaluation of designated transportation network; 22 p., 3 figs., 6 tables, 9 drawings.	6 June 1980
FN-TR-MFR	__________, 1981j, Geotechnical Evaluation, Multi-Frequency Resistivity Studies, 1981l, 7 pp., 2 figs., 5 drawings.	15 April 1981
FN-TR-ETB-1	__________, 1980s, Progress report, geotechnical study for mobility test tracks, ETB mobility study, Nevada Test Site, Nevada; 35 p., 7 tables, 3 app., 13 figs.	29 August 1981

REPORTS WITHOUT TR DESIGNATIONS

	Description	Date of Report
1.	Fugro National, Inc., 1978o, Geotechnical siting status report: Cons. report for SAMSO; v. I, 242 pages, v. II, maps, app.	21 June 1978
2.	__________, 1980a, MX siting investigation, Nevada and Utah water law and procedures for rigths acquisition, water resources program FY 80; 5 p., 2 tables, 1 app.	12 February 1979 revised - 2 June 1980
3.	__________, 1979, MX siting investigation geotechnical summary water resources program, FY 79; 54 p., 2 figs., 3 tables, 12 drawings, 3 app.	21 December 1979
4.	__________, 1980b, Municipal water-supply and wastewater treatment facilities in selected Nevada and Utah communities; 2 p., 4 tables, 2 app.	20 June 1980
5.	__________, 1981b, MX siting investigation, Water Resources Program, Progress Report, 1981c, 34 pp., 6 tables, 2 figs., 8 drawings, 2 app.	September 1980
6.	__________, 1981a, Cone Penetrometer Test Results, Engineering Test Beds Follow-on Mobility Test, 4 app.	19 December 1980
7.	Ertec Western, Inc., Regional Studies for Valley Clustering, 246 pp., 2 app., 1 fig., 4 tables.	21 August 1981
8.	__________, Photo-geologic Interpretation of Geotechnical Conditions and Hazards in Proposed Siting Area of Eastern Coyote Spring Valley, 44 pp., 3 drawings.	28 September 1981
9.	__________, 1981, Aquifer Testing, Dry Lake Valley, Nevada, 32 pp., 11 figs., 1 table.	30 November 1981



Rose Creek
Sonoma Peak
Cosgrave
Tungsten
Don Ore Peak
Mill City
Imlay
Humboldt
HUMBOLDT
PACIFIC
GRASS
VALLEY
RANGE
JUMPERNICK
VALLEY
Valmy
North Peak
BATTLE
MOUNTAIN
Elephant Head
Table Mtn
Goldbanks
Hills
BUENA VISTA
VALLEY
Flat
BUFFALO
VALLEY
MOUNTAINS
Reese
RIVER
Jersey Valley
CREEK
Spring
Chocolate Butte
Cornish
Table Mtn
Logan Peak
ANTELOPE
VALLEY
LAND
Dixie Valley
River
117°
41° 00′
35
34
29
28
27
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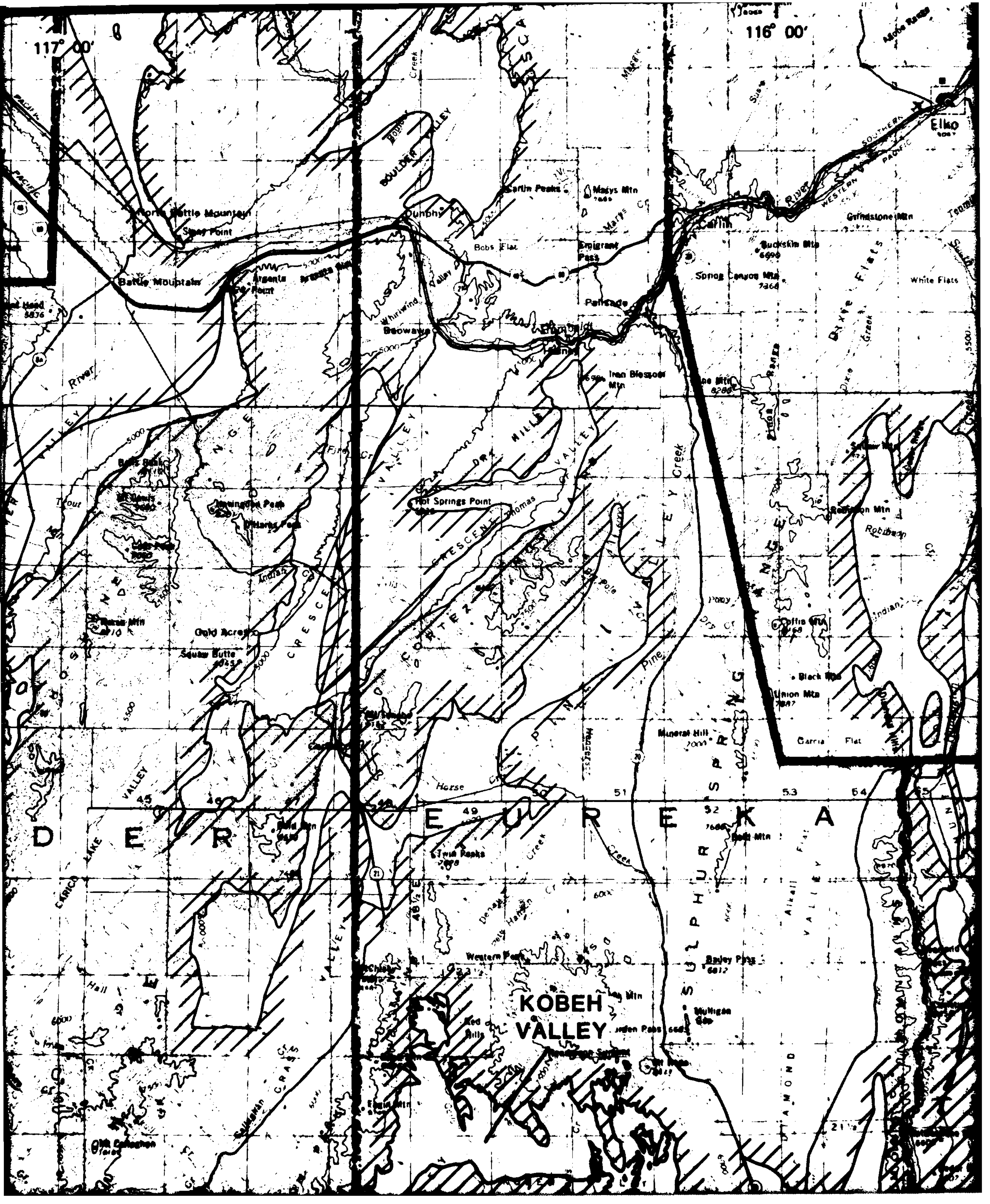
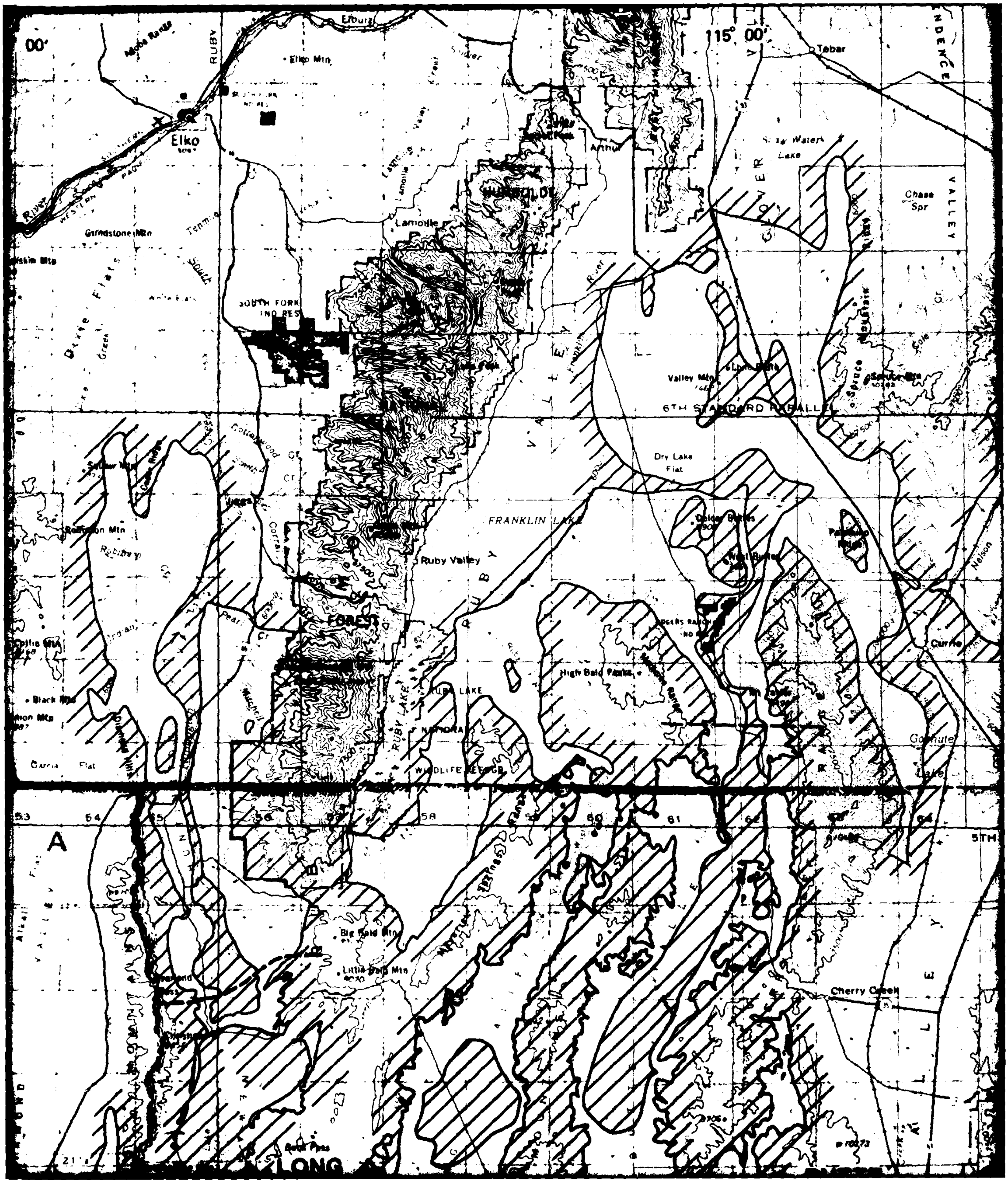
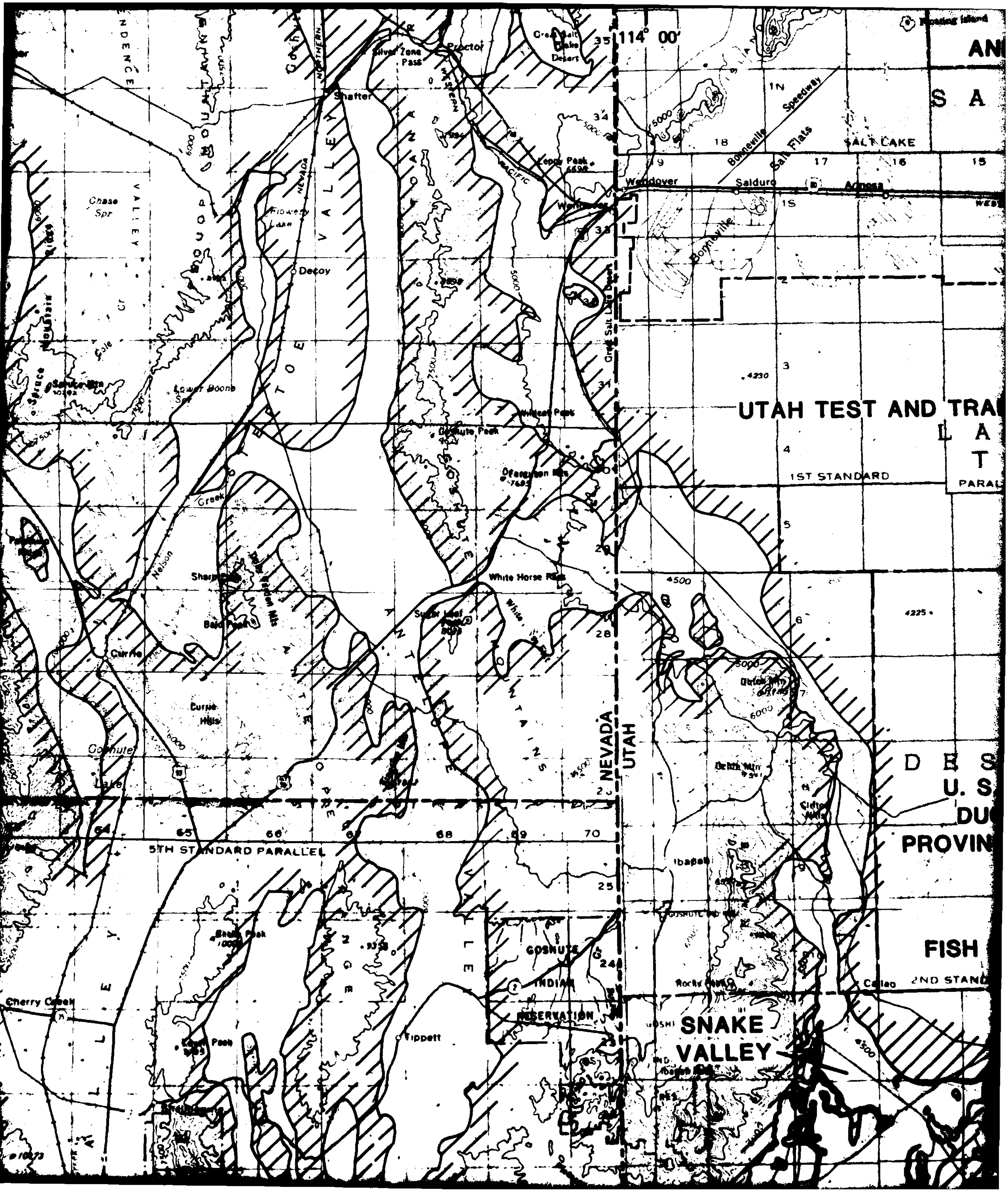
39



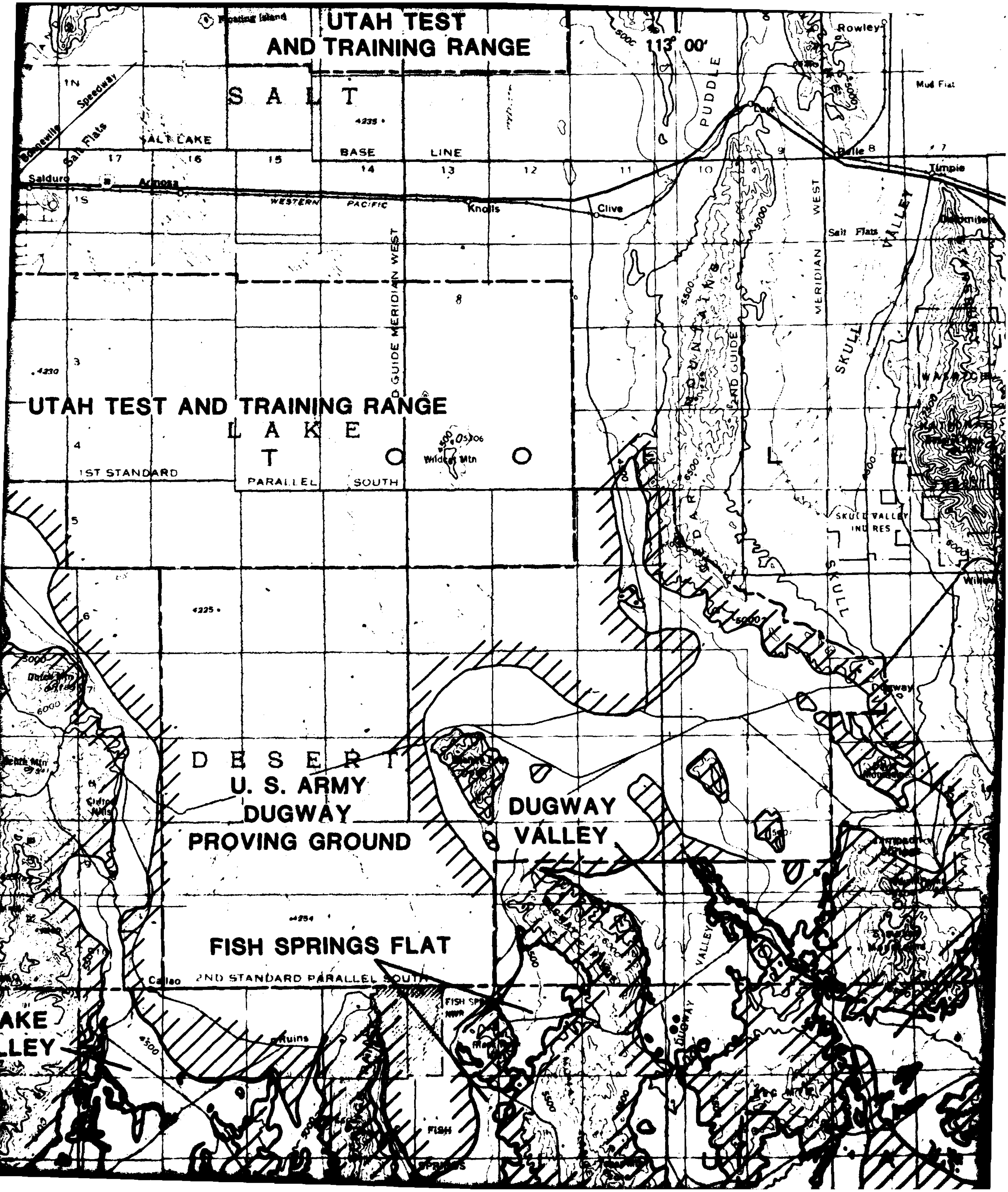
117° 00'
116° 00'
Elko
Carlin
North Battle Mountain
Battle Mountain
Dunphy
Beowawe
Palisade
Carlin Peaks
Marys Mtn
Bobs Flat
Emigrant Pass
Buckskin Mtn
Spring Canyon Mtn
Grindstone Mtn
White Flats
Iron Blossom Mtn
Hot Springs Point
Gold Acres
Squaw Butte
Mineral Hill
Union Mtn
Black Mtn
Twin Peaks
Western Peak
Bailey Pass
Mulligan Gap
KOBEH VALLEY
E U R E K A
D E R



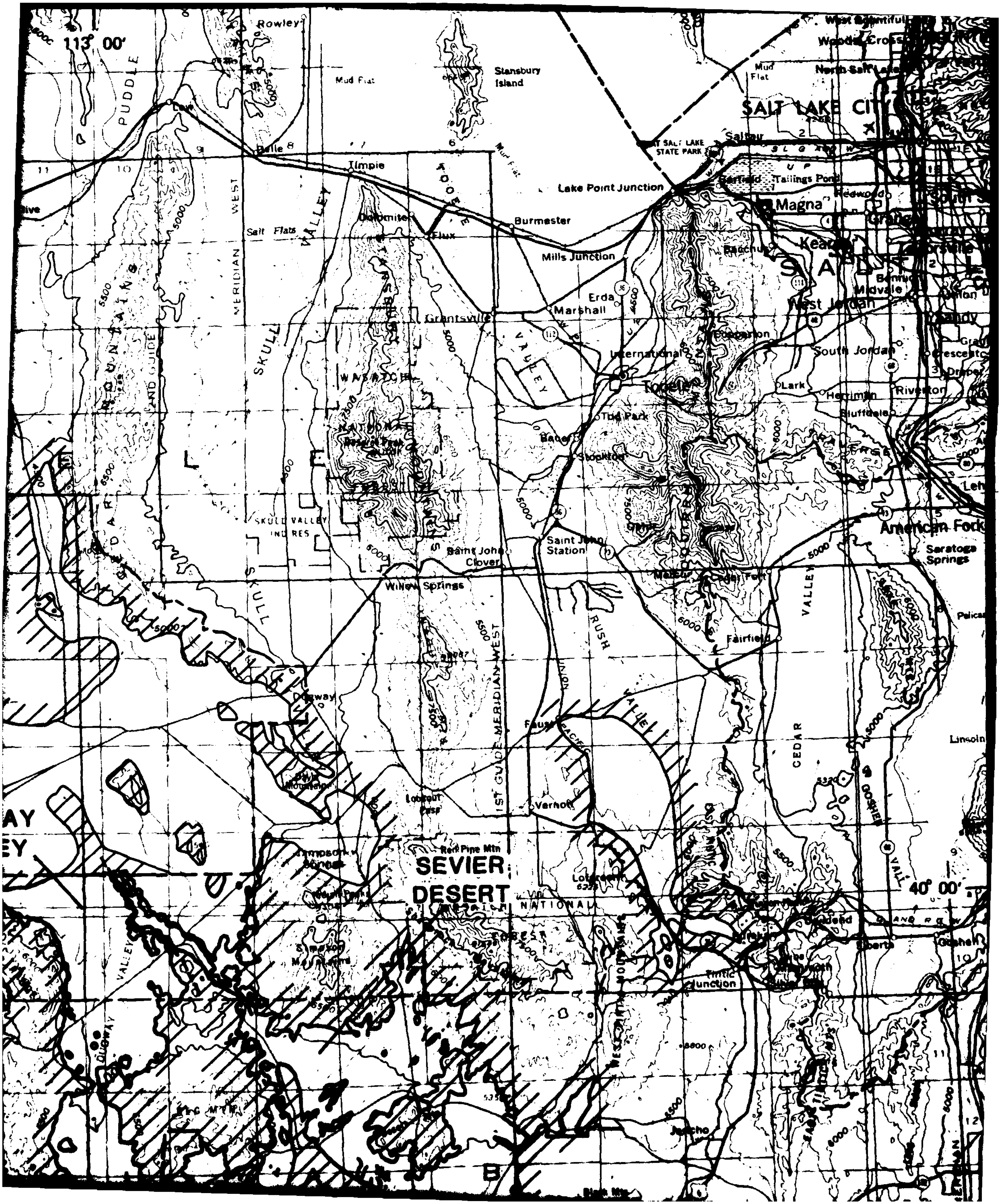
Elburz
115° 00'
Tabar
Elko Mtn
Elko
Lamoille
South Fork Ind Res
Grindstone Mtn
Dixie Flats
Valley Mtn
Spruce Mtn
6TH STANDARD PARALLEL
Dry Lake Flat
FRANKLIN LAKE
Ruby Valley
RUBY LAKE
NATIONAL
WILDLIFE REFUGE
FOREST
High Bald Peak
Big Bald Mtn
Little Bald Mtn
Cherry Creek
Currie
Nelson
Goshute Lake
Black Mtn
Garcia Flat
Chase Spr
A
5TH
53
54
55
56
57
58
60
61
62
64
LONG



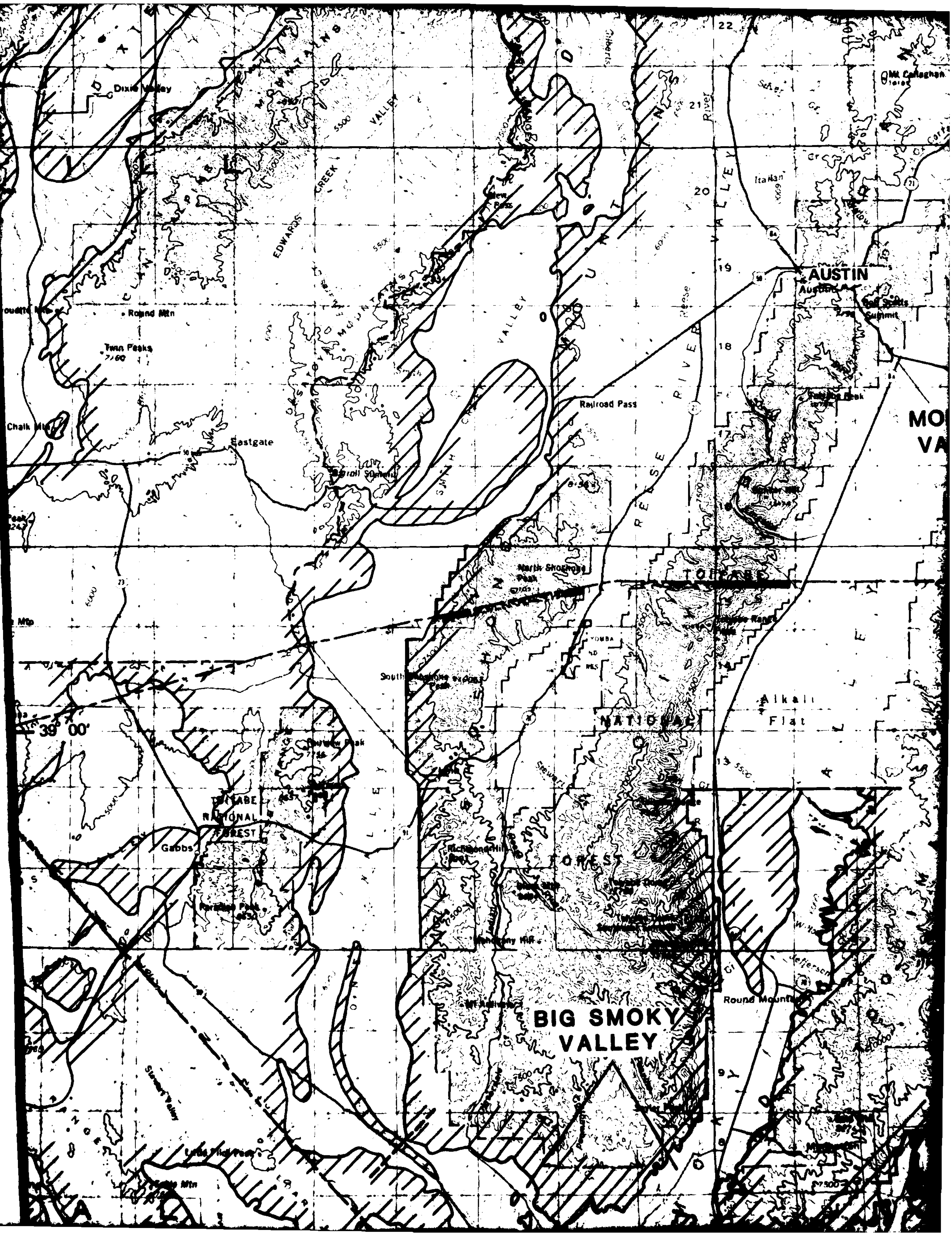
114° 00'
Floating Island
Great Salt Lake Desert
Silver Zone Pass
Proctor
Shafter
Pilot Peak
Wendover
Salduro
Arinosa
Bonneville Salt Flats
Bonneville Speedway
SALT LAKE
Flowery Lake
Decoy
Chase Spr
Lower Boone Spr
Spruce Mtn
Goshute Peak
Ferguson Mtn
Wildcat Peak
Creek
Nelson
Sharp Peak
Bald Peak
White Horse Pass
Sugar Loaf Peak
Currie
Currie Hills
Goshute
Lake
UTAH TEST AND TRA
1ST STANDARD
PARAL
5TH STANDARD PARALLEL
NEVADA
UTAH
Ibapah
Cherry Creek
GOSHUTE
INDIAN
RESERVATION
Tippett
SNAKE
VALLEY
Callao
2ND STAND
FISH
D E S
U. S
DU
PROVIN
Clifton Hills
4500
5000
6000
4230
4225
64
65
66
67
68
69
70



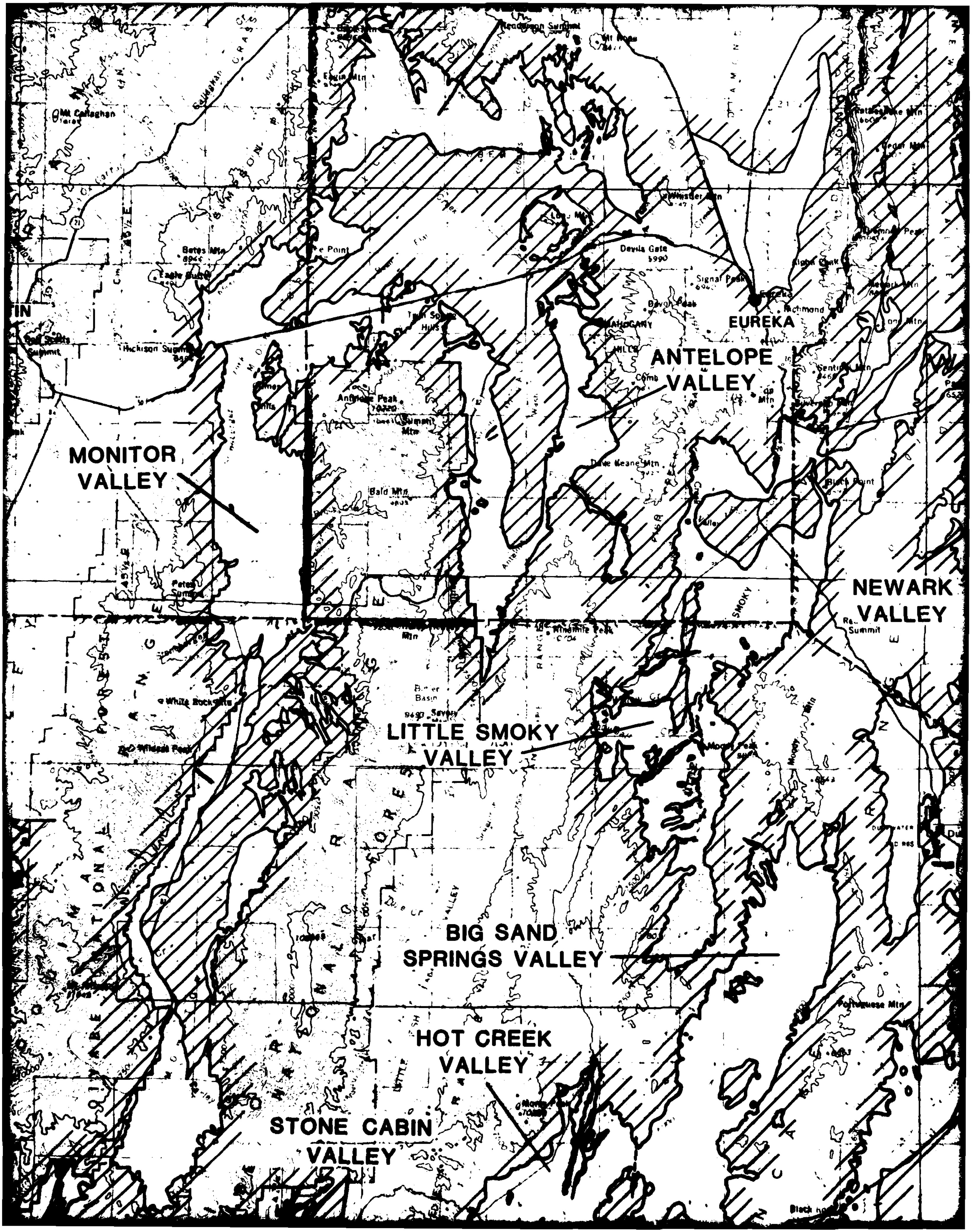
UTAH TEST AND TRAINING RANGE
113° 00'
SALT
LAKE
BASE LINE
WESTERN PACIFIC
Saldura
Arinosa
Knolls
Clive
Rowley
Mud Flat
Timpie
Salt Flats
PUDDLE
WEST MERIDIAN
GUIDE MERIDIAN WEST
SKULL VALLEY
UTAH TEST AND TRAINING RANGE
LAKE
T O O E L E
1ST STANDARD PARALLEL SOUTH
Wildcat Mtn
SKULL VALLEY IND RES
SKULL
Dugway
DESERT
U. S. ARMY
DUGWAY
PROVING GROUND
DUGWAY
VALLEY
FISH SPRINGS FLAT
2ND STANDARD PARALLEL SOUTH
Callao
FISH SPRINGS NWR
DUGWAY
VALLEY
FISH
SPRINGS
AKE
LLEY

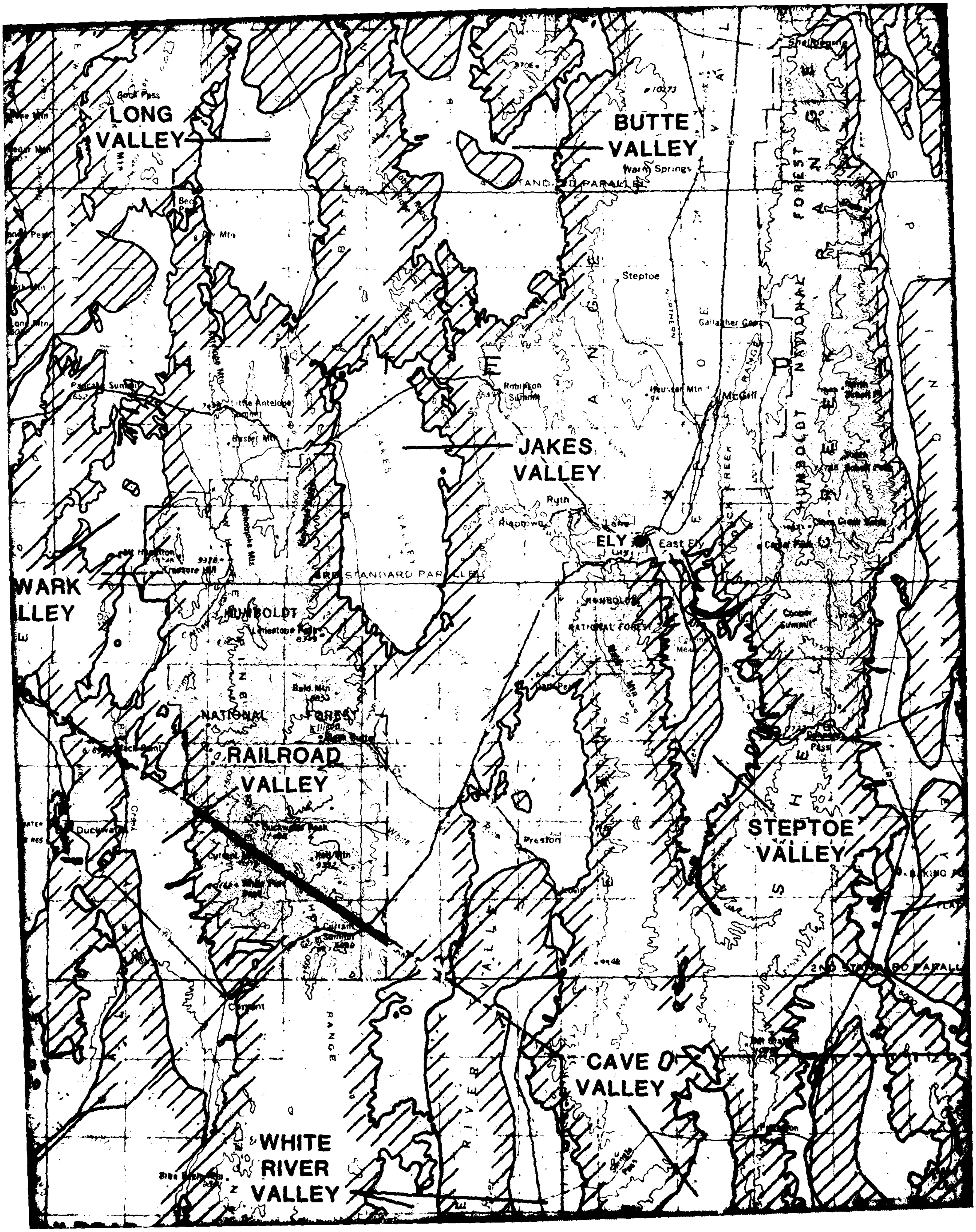


113° 00'
Rowley
Stansbury Island
Mud Flat
SALT LAKE CITY
Saltair
Lake Point Junction
Tailings Pond
Magna
Timpie
Dolomite
Flux
Burmester
Mills Junction
Salt Flats
Erda
Marshall
Grantsville
West Jordan
South Jordan
International
Tooele
Lark
Herriman
Riverton
Stockton
Saint John Station
Clover
Willow Springs
American Fork
Saratoga Springs
Fairfield
SKULL VALLEY
RUSH
CEDAR
VALLEY
Dugway
Faust
Vernon
SEVIER DESERT
Red Pine Mtn
40° 00'
Tintic Junction
Jericho
GOSHEN

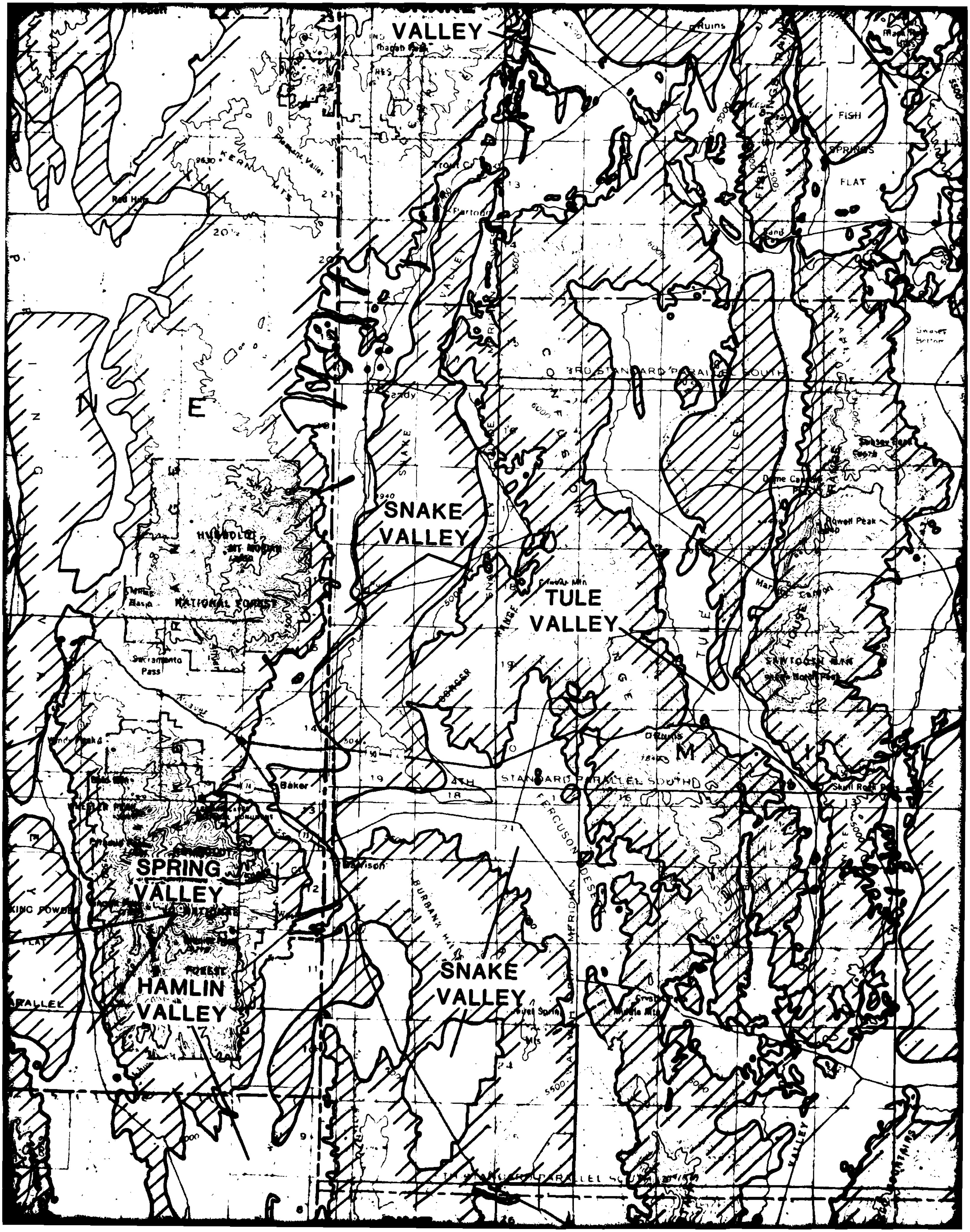


Dixie Valley
Round Mtn
Twin Peaks
Chalk Mtn
Eastgate
EDWARDS CREEK VALLEY
New Pass
Railroad Pass
AUSTIN
Mt Callaghan
North Shoshone Peak
TOIYABE NATIONAL FOREST
Alkali Flat
39°00'
Gabbs
Round Mountain
BIG SMOKY VALLEY

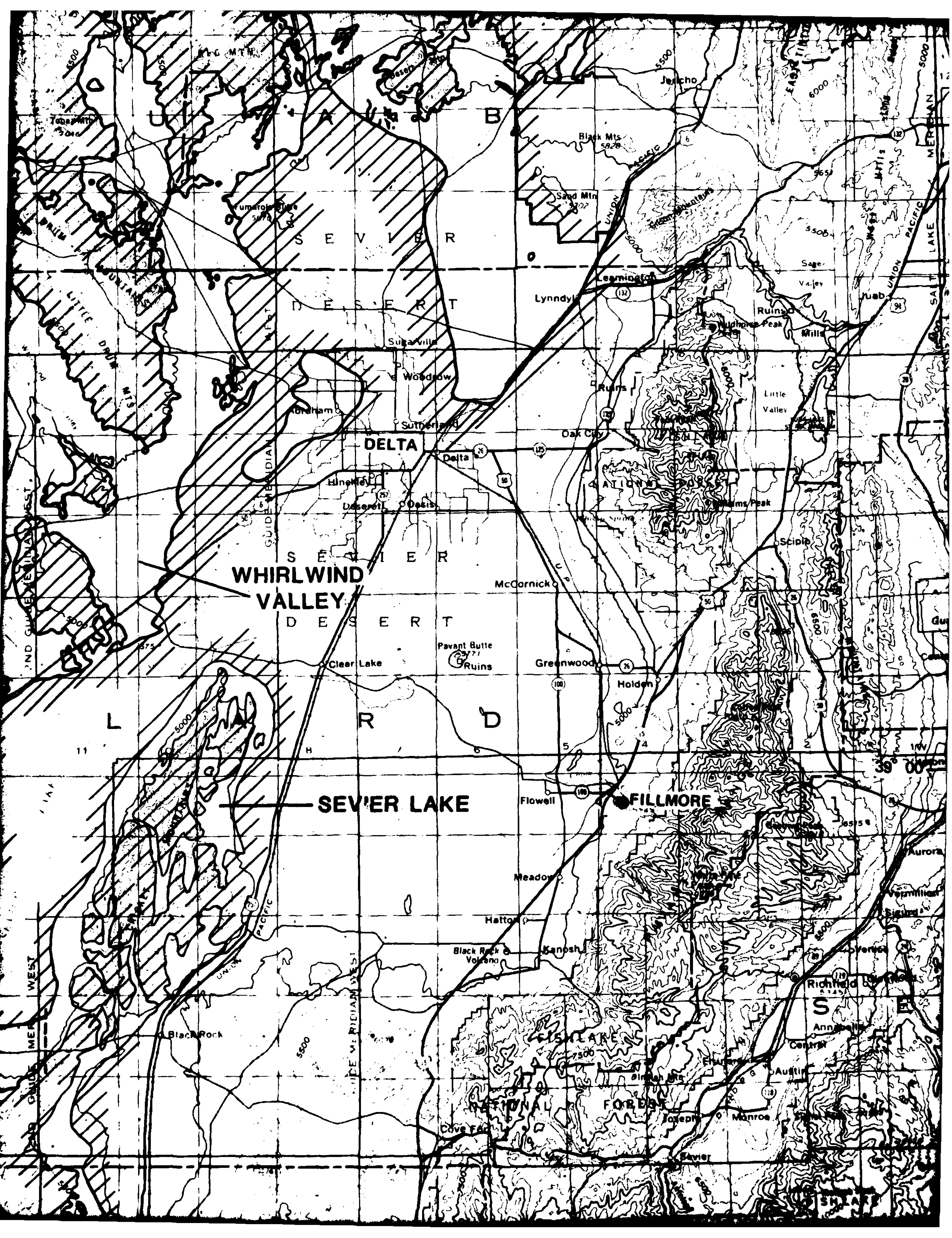

ANTELOPE VALLEY
MONITOR VALLEY
NEWARK VALLEY
LITTLE SMOKY VALLEY
BIG SAND SPRINGS VALLEY
HOT CREEK VALLEY
STONE CABIN VALLEY
EUREKA
Devils Gate
Signal Peak
Bates Mtn
Hickison Summit
Antelope Peak
Bald Mtn
Moody Peak
Portuguese Mtn
Mt Callaghan
Whistler Mtn
Richmond



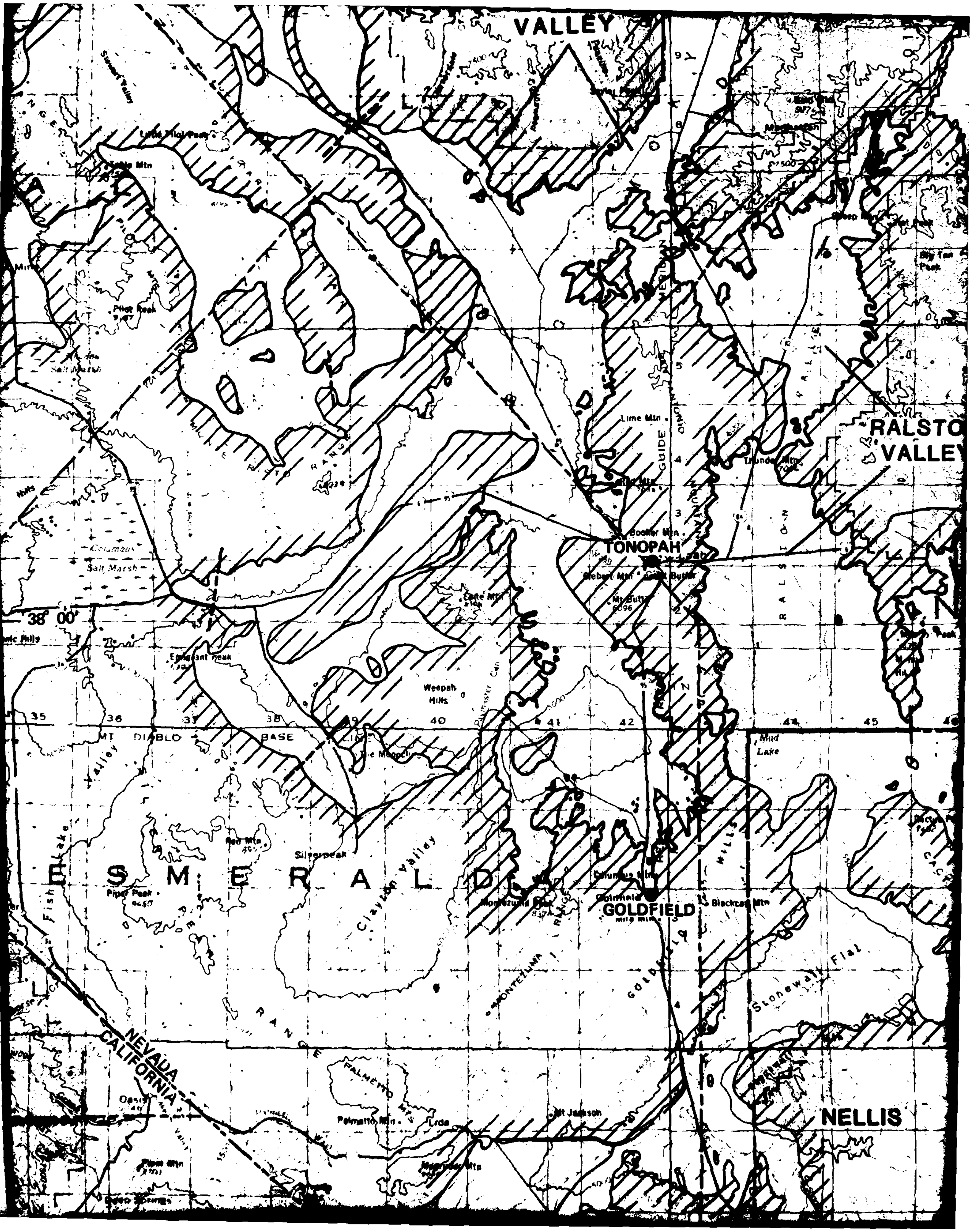
LONG VALLEY
BUTTE VALLEY
Warm Springs
JAKES VALLEY
Steptoe
Robinson Summit
Pancake Summit
Little Antelope Summit
Buster Mtn
McGill
ELY
East Ely
Ruth
Riepetown
WARK VALLEY
HUMBOLDT
NATIONAL FOREST
HUMBOLDT NATIONAL FOREST
Bald Mtn
RAILROAD VALLEY
Duckwater
Currant
Preston
STEPTOE VALLEY
CAVE VALLEY
WHITE RIVER VALLEY
2ND STANDARD PARALLEL



VALLEY
SNAKE VALLEY
TULE VALLEY
SPRING VALLEY
HAMLIN VALLEY
SNAKE VALLEY
FISH SPRINGS FLAT
3RD STANDARD PARALLEL SOUTH
4TH STANDARD PARALLEL SOUTH
FERGUSON DESERT
Baker
Sacramento Pass
Red Hills
Powell Peak
Sandy



WHIRLWIND
VALLEY
SEVIER LAKE
DELTA
FILLMORE
SEVIER
DESERT
SEVIER
DESERT
L A R D
Jericho
Black Mts
Sand Mtn
Leamington
Lynndyl
Juab
Mills
Sugarville
Woodrow
Abraham
Sutherland
Oak City
Delta
Hinckley
Deseret
Oasis
Scipio
McCornick
Pavant Butte
Ruins
Clear Lake
Greenwood
Holden
Flowell
Meadow
Hatton
Kanosh
Black Rock Volcano
Black Rock
Cove Fort
Little Valley
Williams Peak
Aurora
Sigurd
Richfield
Annabella
Central
Elsinore
Monroe
Joseph
Sevier
Austin
NATIONAL
FOREST
UNION
PACIFIC
GUIDE MERIDIAN WEST
39° 00'


VALLEY
RALSTON VALLEY
TONOPAH
GOLDFIELD
NELLIS
E S M E R A L D A
NEVADA
CALIFORNIA
MT DIABLO BASE LINE
38° 00'
Columbus Salt Marsh
Weepah Hills
Clayton Valley
Silverpeak
Fish Lake Valley
MONTEZUMA RANGE
PALMETTO MTS
Stonewall Flat
Mud Lake
Lime Mtn
Booker Mtn
Mt Butler
Lone Mtn
Red Mtn
Pilot Peak
Montezuma Peak
Blackcap Mtn
Columbus Mtn
Mt Jackson
Palmetto Mtn
Lida
Oasis
GUIDE MERIDIAN
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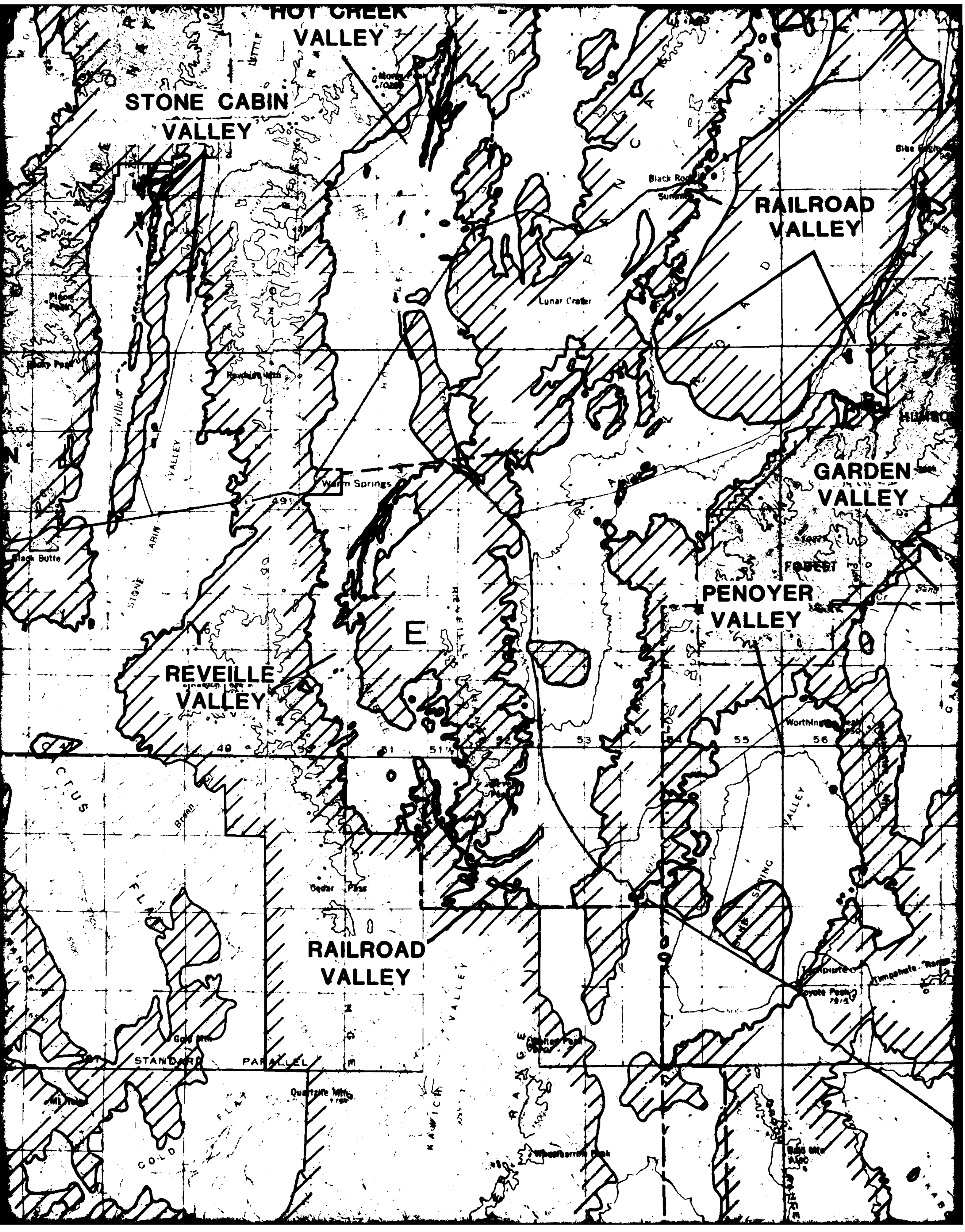
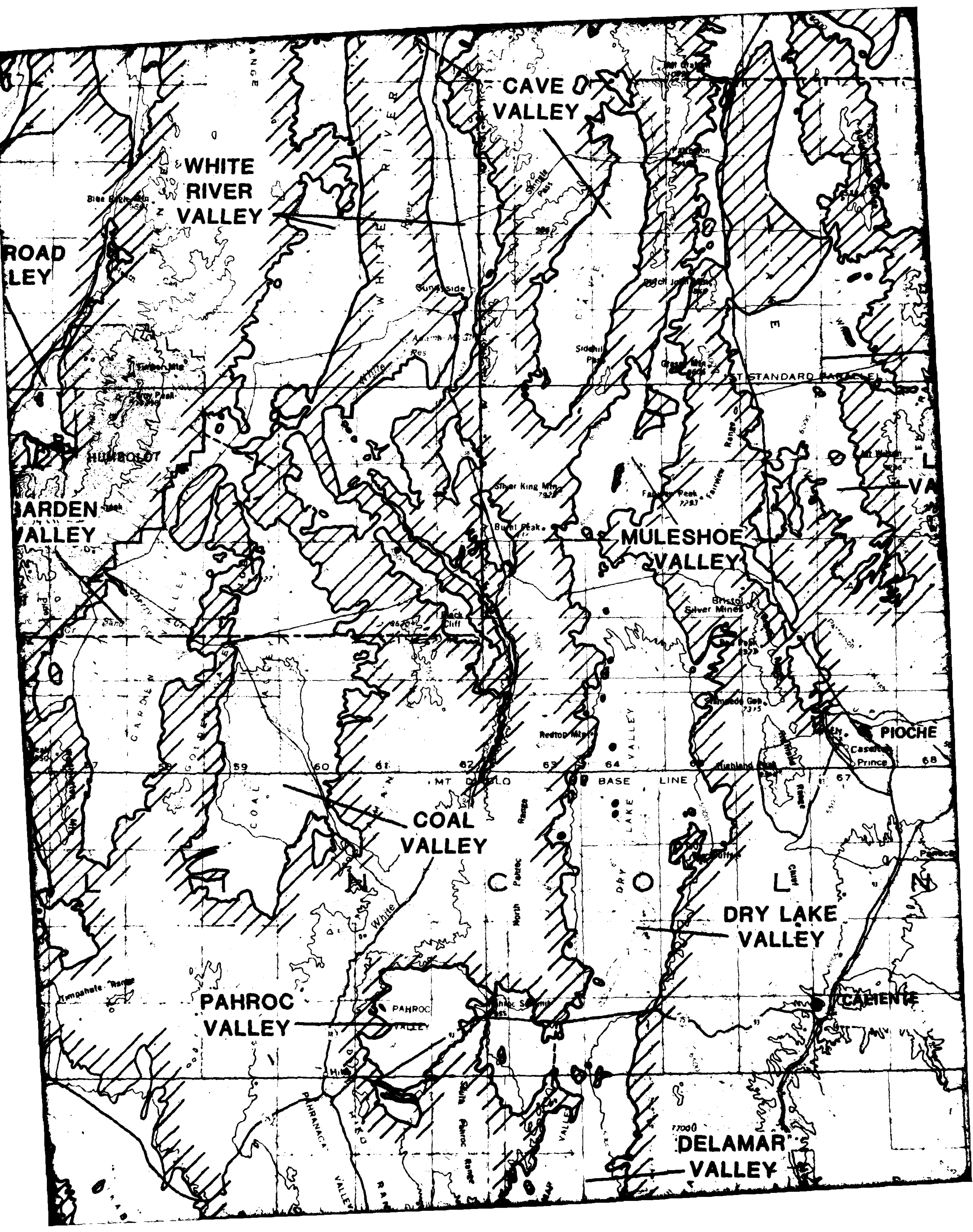


HOT CREEK VALLEY
STONE CABIN VALLEY
RAILROAD VALLEY
Black Rock Summit
Lunar Crater
GARDEN VALLEY
Warm Springs
491
Black Butte
FOREST
PENOYER VALLEY
E
REVEILLE VALLEY
Worthington Peak
49
51
51½
53
54
55
56
57
Cedar Pass
RAILROAD VALLEY
STANDARD PARALLEL
Gold Mtn
Quartzite Mtn
Wheelbarrow Peak
GOLD FLAT
KAWICH VALLEY
Coyote Peak



CAVE VALLEY
WHITE RIVER VALLEY
ROAD VALLEY
HUMBOLDT
GARDEN VALLEY
MULESHOE VALLEY
Silver King Mtn
Burnt Peak
Bristol Silver Mines
PIOCHE
Caselton
Prince
Redtop Mtn
BASE LINE
MT DIABLO
COAL VALLEY
DRY LAKE VALLEY
North Pahroc Range
PAHROC VALLEY
Tempahute Range
CALIENTE
DELAMAR VALLEY
1ST STANDARD PARALLEL
59
60
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62
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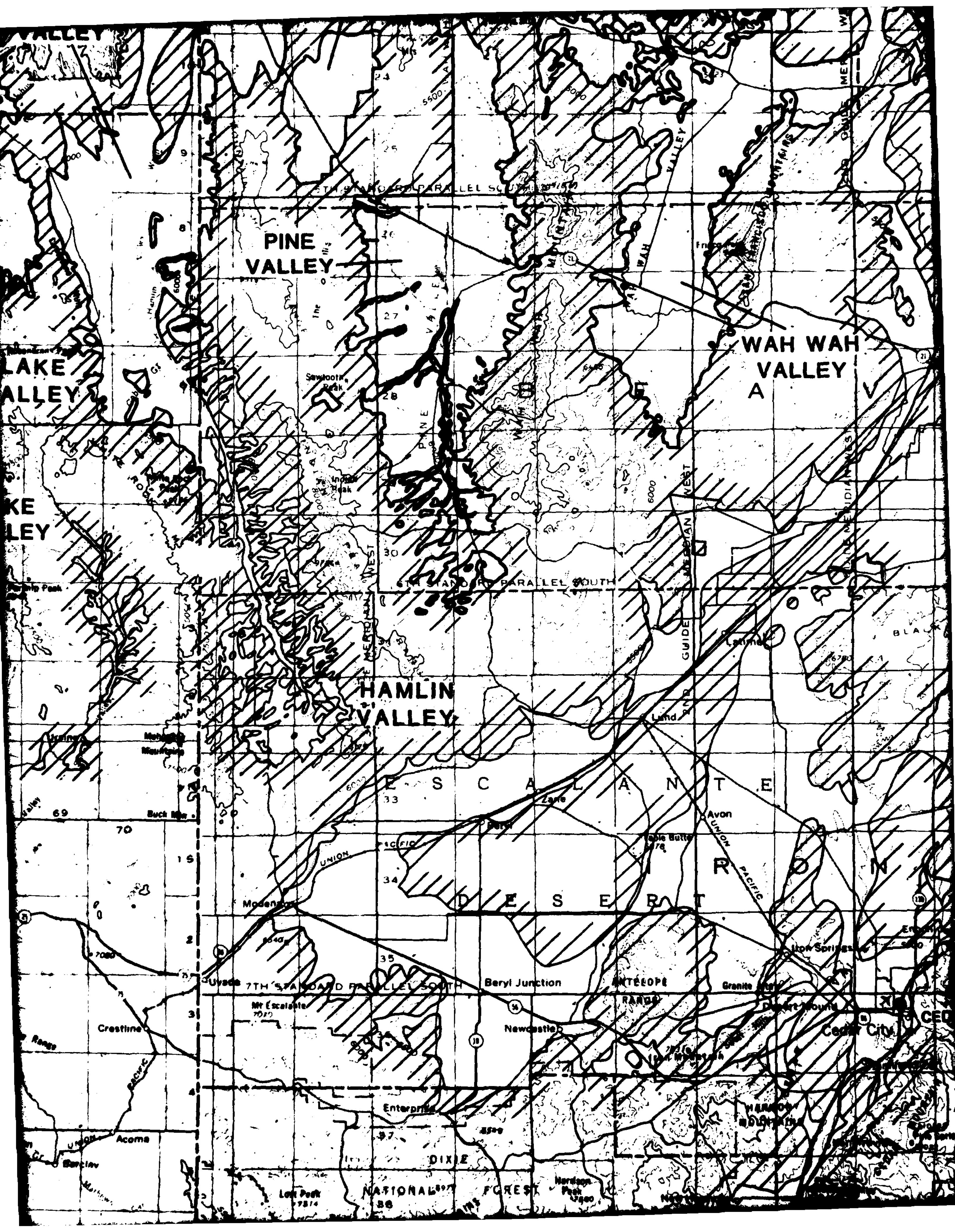
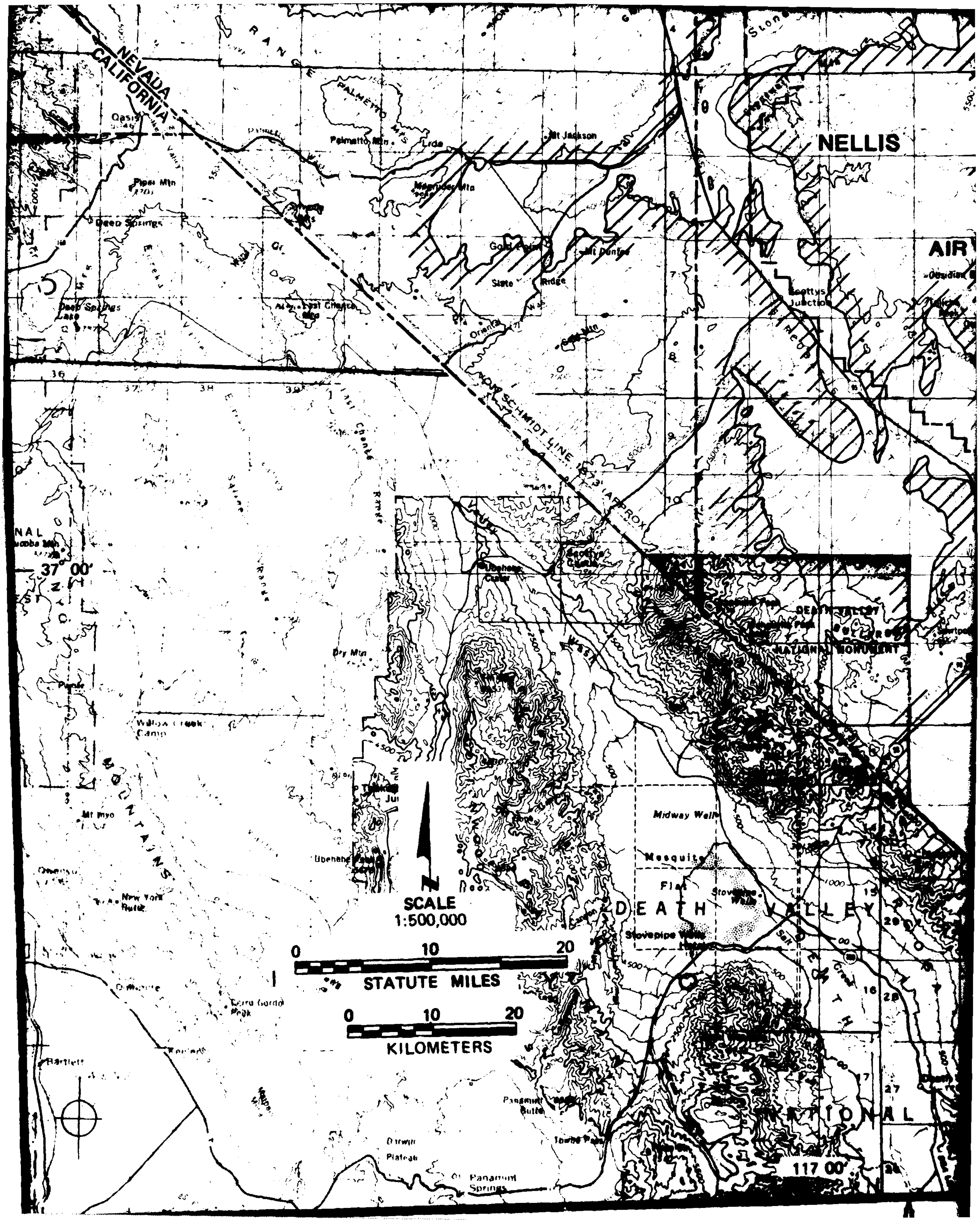
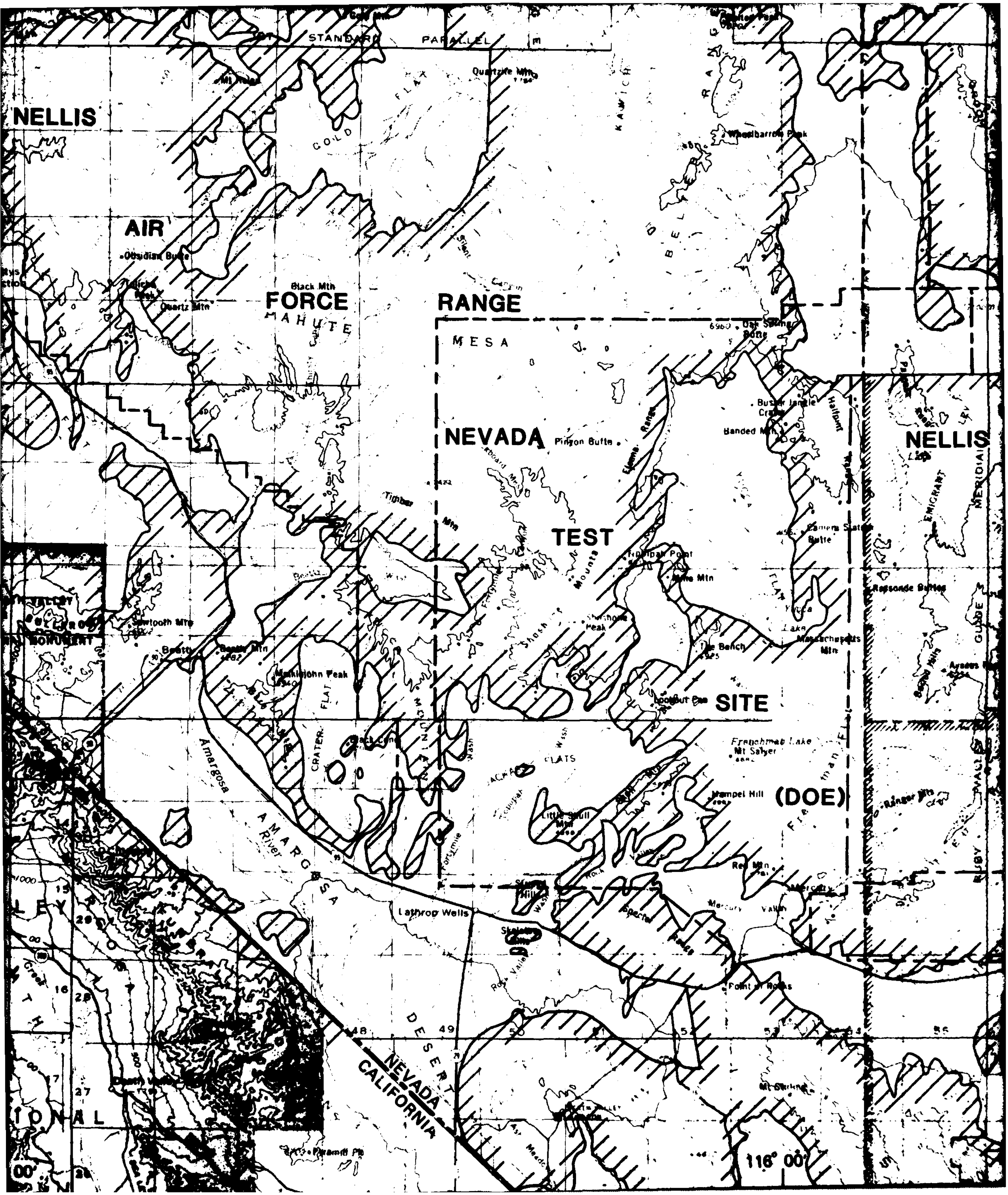
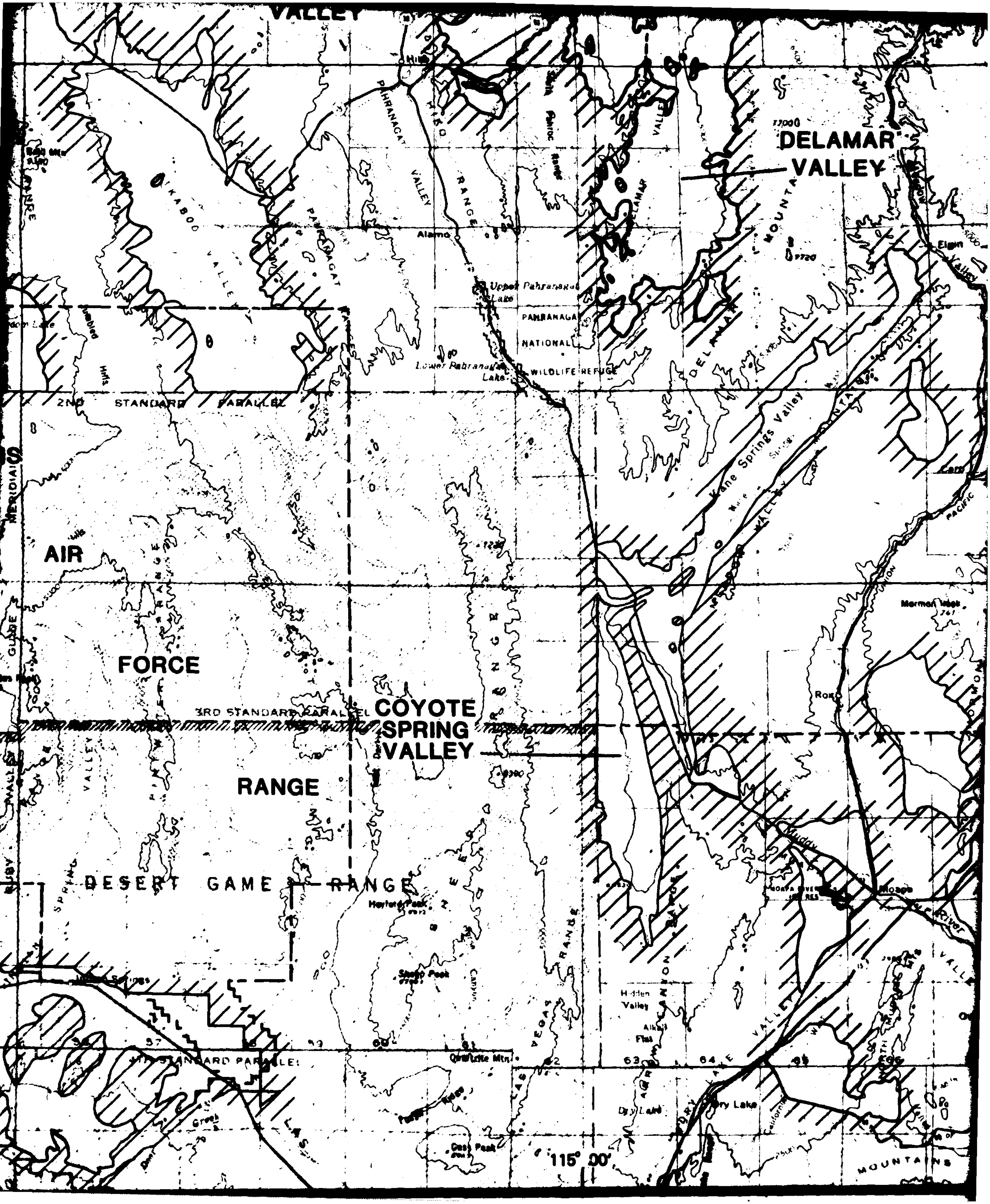
64
67
68

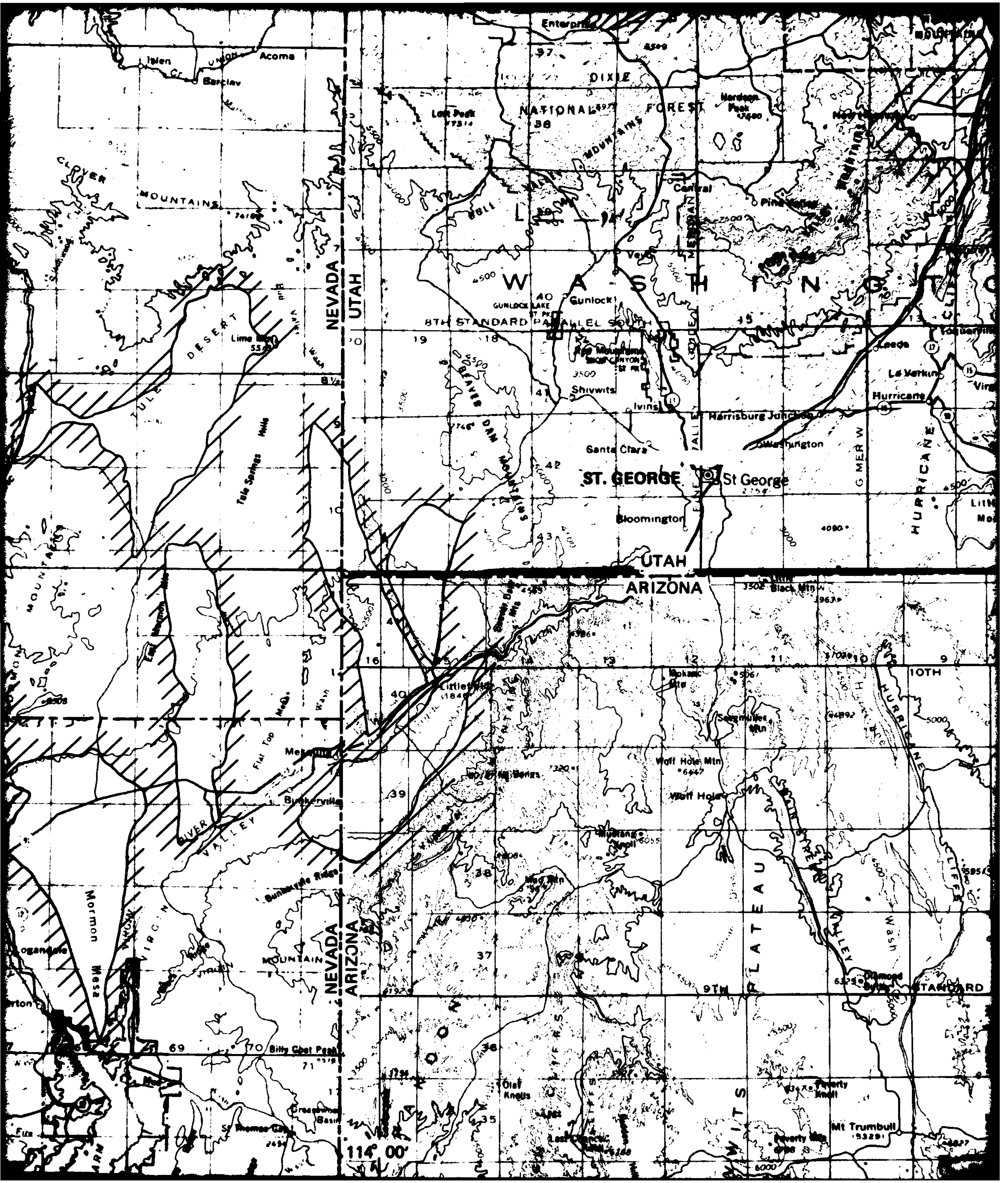

PINE VALLEY
WAH WAH VALLEY
LAKE VALLEY
HAMLIN VALLEY
6TH STANDARD PARALLEL SOUTH
7TH STANDARD PARALLEL SOUTH
GUIDE MERIDIAN WEST
Sawtooth Peak
Indian Peak
E S C A L A N T E
I R O N
D E S E R T
Lund
Zane
Beryl
Avon
Table Butte
UNION PACIFIC
Modena
Uvada
Beryl Junction
ANTELOPE RANGE
Granite
Iron Springs
Desert Mound
Cedar City
Mt Escalante
Newcastle
Crestline
Enterprise
Acoma
DIXIE
NATIONAL
FOREST
Lost Peak

Black Rock
FISHLAKE
NATIONAL
FOREST
Annabella
Central
Elsinore
Austin
Joseph
Monroe
Cove Fort
Sevier
Monroe Peak
WAH
LLEY
MILFORD
Manderfield
Marysvale
Thompsonville
Alunite
Bradshaw Mountain
Adamsville
Greenville
BEAVER
Beaver
Junction
Kingston
Minersville
Black Mtn
Circleville
BLACK MOUNTAINS
Antimony
38°00'
Panguitch
DIXIE
NATIONAL
FOREST
Paragonah
PAROWAN
Summit
Enoch
CEDAR CITY
Cedar City
NATIONAL
FOREST
CEDAR BREAKS
Hatch
Rubys Inn
Tropic
BRYCE CANYON
Cannonville
GUIDE MERIDIAN
VALLEY

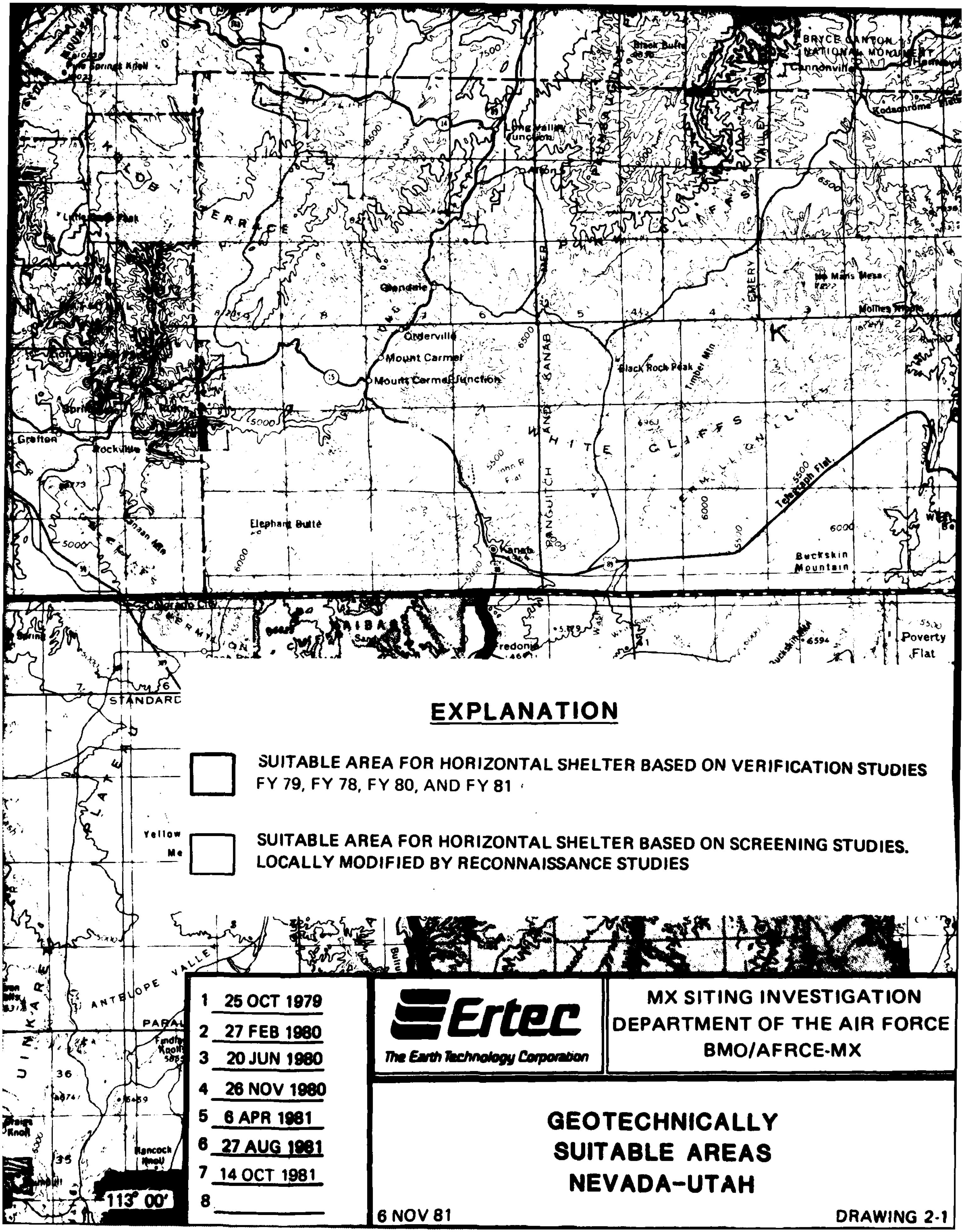

NEVADA
CALIFORNIA
NELLIS
AIR
Oasis
Palmetto Mtn
Mt Jackson
Piper Mtn
Deep Springs
Gold Point
State
Ridge
Scottys
Junction
Deep Springs
Lake
Last Chance
Oriental
NON SCHMIDT LINE
APPROX
37° 00'
DEATH VALLEY
NATIONAL MONUMENT
Ubehebe
Crater
Dry Mtn
Willow Creek
Camp
MOUNTAINS
Mt Inyo
New York
Butte
Midway Well
Mesquite
Flat
Stovepipe Wells
Stovepipe Wells
Hotel
DEATH VALLEY
SCALE
1:500,000
0
10
20
STATUTE MILES
0
10
20
KILOMETERS
Cerro Gordo
Peak
Bartlett
Panamint
Butte
Towne Pass
Darwin
Plateau
Panamint
Springs
NATIONAL
117 00'


NELLIS
AIR
FORCE
RANGE
NEVADA
TEST
SITE
(DOE)
NELLIS
STANDARD
PARALLEL
Quartzite Mtn
Wheelbarrow Peak
Obsidian Butte
Black Mtn
Quartz Mtn
MESA
Pinyon Butte
Banded Mtn
Timber
Beatty
Beatty Mtn
Sawtooth Mtn
Meiklejohn Peak
Shoshone Peak
Massachusetts Mtn
The Bench
Lookout Pea
Frenchman Lake
Mt Salyer
Hampel Hill
Little Skull Mtn
Red Mtn
Mercury Valley
Lathrop Wells
Point of Rocks
Amargosa
AMARGOSA
River
DESERT
NEVADA
CALIFORNIA
CRATER
FLAT
FLATS
EMIGRANT
116° 00'


DELAMAR VALLEY
COYOTE SPRING VALLEY
AIR
FORCE
RANGE
DESERT GAME RANGE
PAHRANAGAT NATIONAL WILDLIFE REFUGE
Upper Pahranagat Lake
Lower Pahranagat Lake
Alamo
2ND STANDARD PARALLEL
3RD STANDARD PARALLEL
Kane Springs Valley
Moapa
Hidden Valley
Dry Lake
115° 00'



Enterprise
DIXIE
NATIONAL
FOREST
MOUNTAINS
Hardscrabble Peak
Lost Peak
CLOVER
MOUNTAINS
Acoma
Barclay
Central
Pine Valley
Veyo
W A S H I N G T O
Gunlock
GUNLOCK LAKE
8TH STANDARD PARALLEL SOUTH
Lime Mtn
DESERT
TULE
NEVADA
UTAH
Shivwits
Ivins
Leeds
La Verkin
Hurricane
Harrisburg Junction
Washington
Santa Clara
ST. GEORGE
St George
Bloomington
BEAVER DAM
MOUNTAINS
HURRICANE
UTAH
ARIZONA
Black Mtn
Littlefield
Mesquite
Bunkerville
Flat Top Mesa
Tule Springs
Wolf Hole Mtn
Wolf Hole
Mustang Knoll
Mud Mtn
10TH
HURRICANE
CLIFFS
PLATEAU
VIRGIN
RIVER
VALLEY
Bunkerville Ridge
MOUNTAIN
NEVADA
ARIZONA
Mormon
Mesa
Logandale
Billy Goat Peak
9TH
STANDARD
Diamond Butte
Olaf Knolls
Poverty Knoll
Mt Trumbull
St Thomas Gap
Last Chance
114° 00'
Whitmore
Poverty Mtn



EXPLANATION

SUITABLE AREA FOR HORIZONTAL SHELTER BASED ON VERIFICATION STUDIES FY 79, FY 78, FY 80, AND FY 81

SUITABLE AREA FOR HORIZONTAL SHELTER BASED ON SCREENING STUDIES. LOCALLY MODIFIED BY RECONNAISSANCE STUDIES

1 25 OCT 1979
2 27 FEB 1980
3 20 JUN 1980
4 26 NOV 1980
5 6 APR 1981
6 27 AUG 1981
7 14 OCT 1981
8 ______

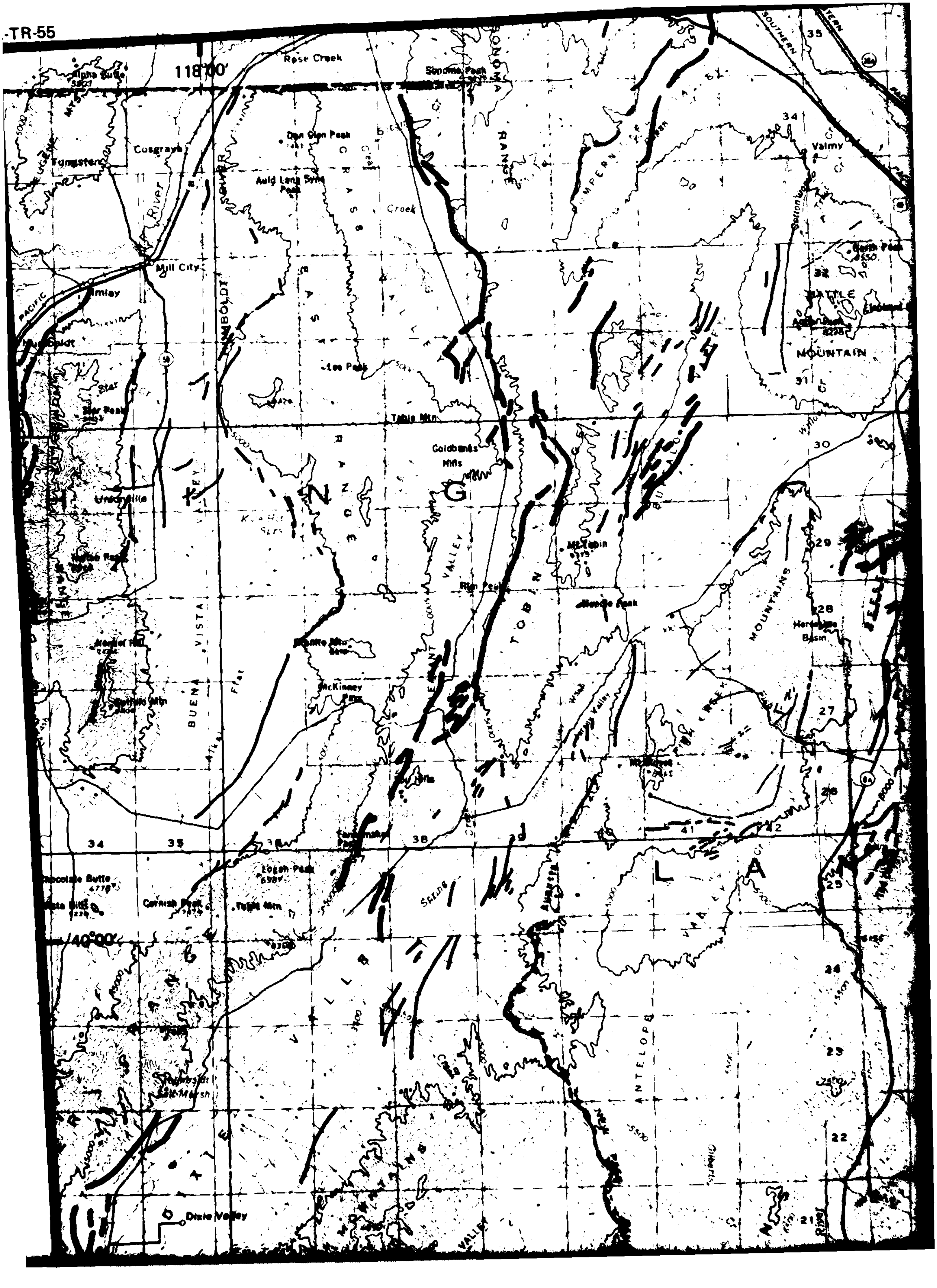
Ertec
The Earth Technology Corporation

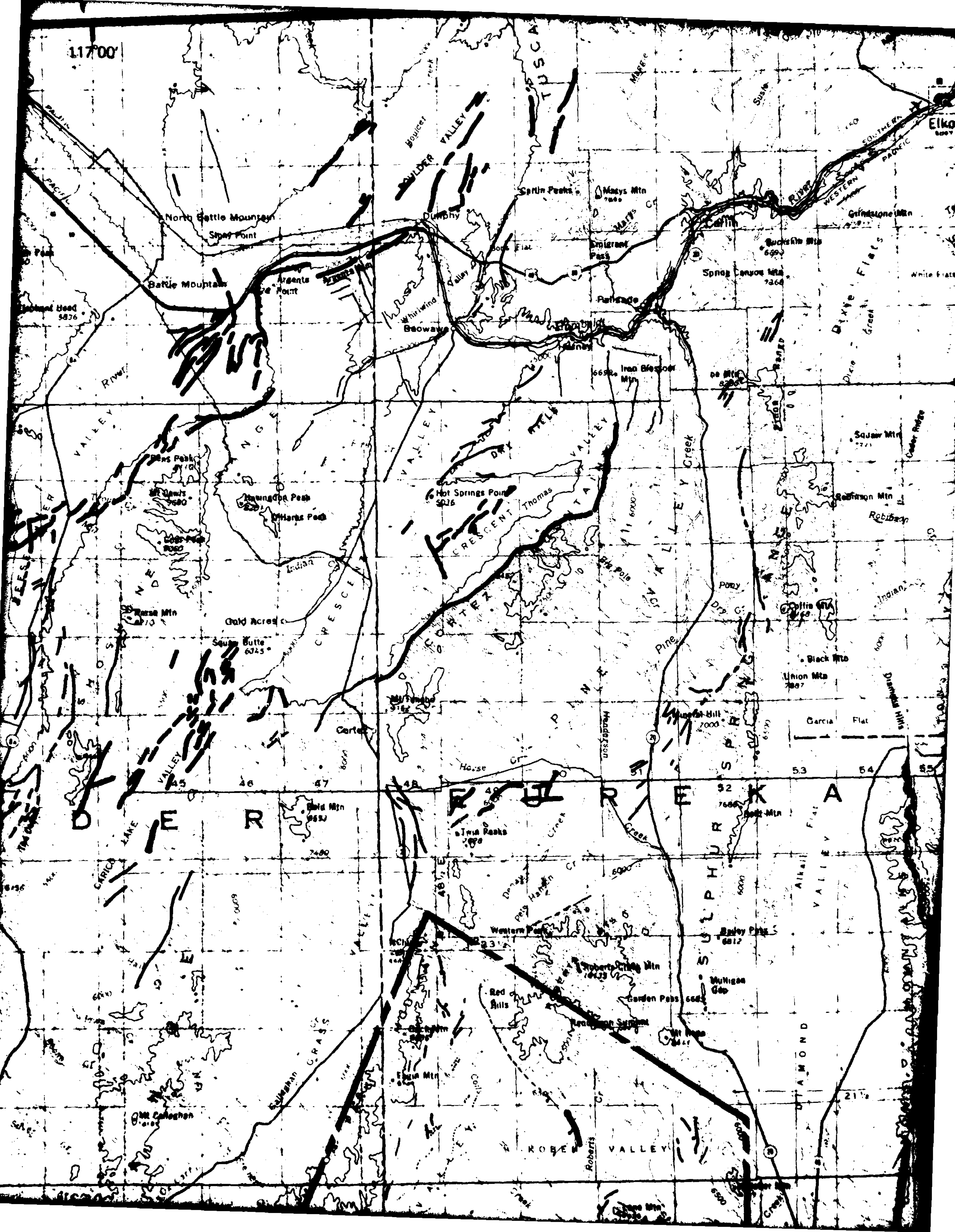
MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

GEOTECHNICALLY SUITABLE AREAS NEVADA-UTAH

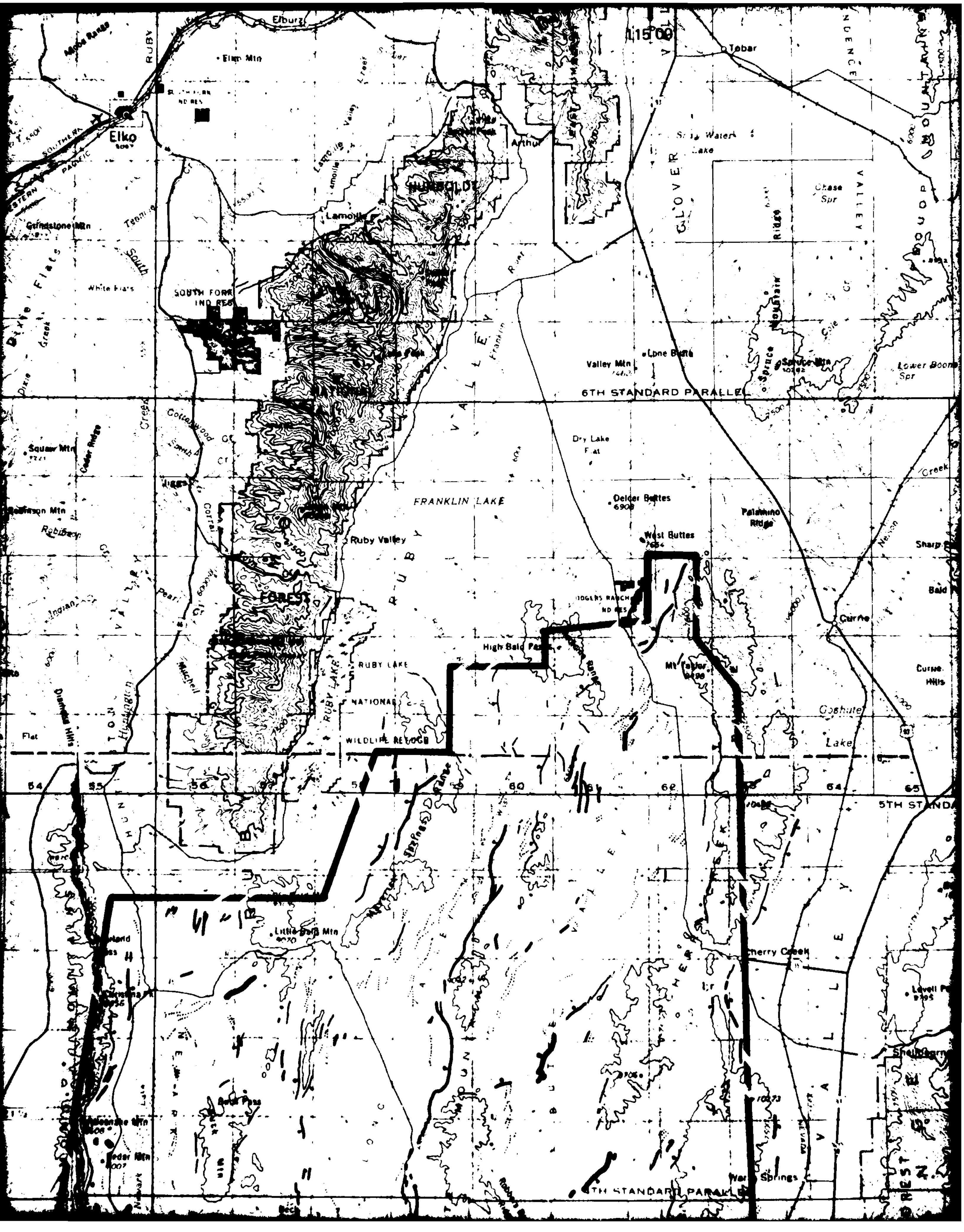
6 NOV 81

DRAWING 2-1

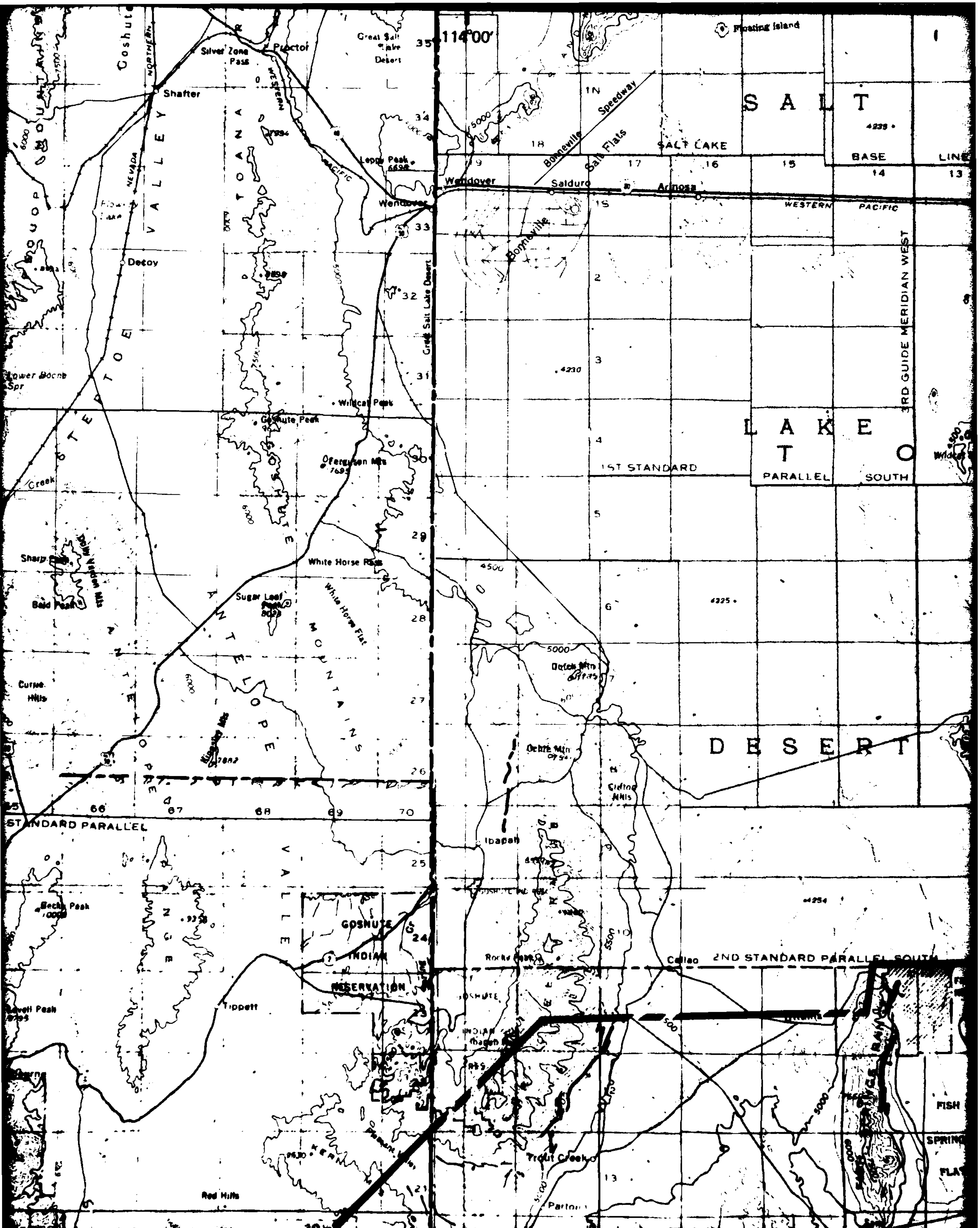

118°00'
Rose Creek
Sonoma Peak
Alpha Butte
Tungsten
Cosgrave
Auld Lang Syne Peak
Mill City
Imlay
Humboldt
PACIFIC
River
HUMBOLDT
Star Peak
Unionville
Lee Peak
Table Mtn
Goldbanks Hills
Valmy
SOUTHERN
North Peak
BATTLE
MOUNTAIN
Antler Peak
RANGE
BUENA VISTA
VALLEY
TOBIN
Mt Tobin
Needle Peak
Granite Mtn
McKinney Pass
MOUNTAINS
Horseshoe Basin
Chocolate Butte
Cornish Peak
Logan Peak
Table Mtn
40°00'
ANTELOPE
Dixie Valley
Salt Marsh
VALLEY
34
35
36
38
39
41
42
35
34
32
31
30
29
28
27
26
25
24
23
22
21



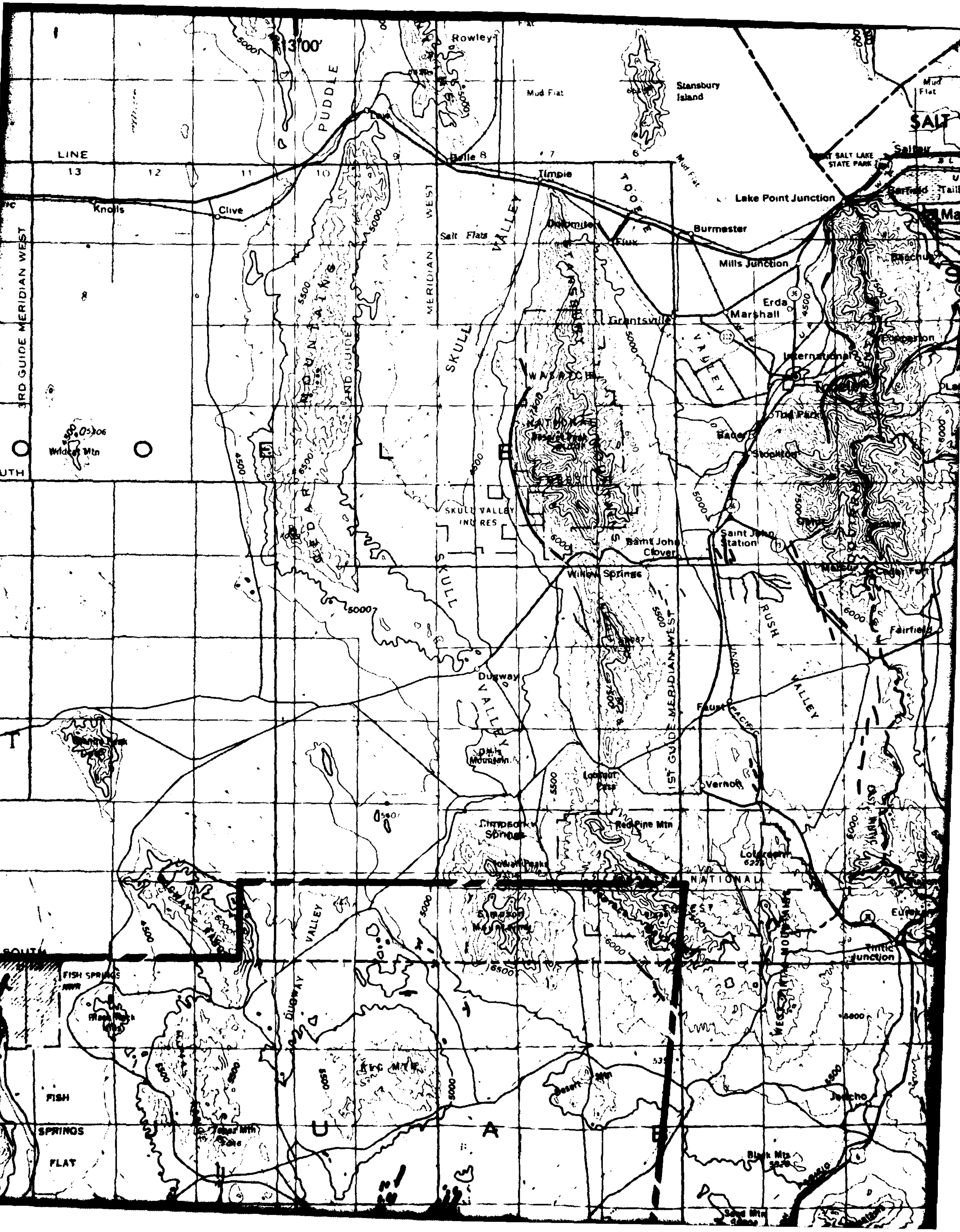
117°00'
Elko
Carlin
Carlin Peaks
Marys Mtn
Dunphy
North Battle Mountain
Battle Mountain
Argenta Point
Beowawe
Palisade
Emigrant Pass
Spring Canyon Mtn
7364
Grindstone Mtn
Iron Blossom Mtn
Hot Springs Point
5026
Squaw Mtn
Robinson Mtn
Mt Lewis
Gold Acres
Squaw Butte
6345
Cortez
Mt Tenabo
Mineral Hill
7000
Union Mtn
Black Mtn
Coffin Mtn
Garcia Flat
Diamond Hills
Gold Mtn
Twin Peaks
Western Peak
Bailey Pass
6812
Mulligan Gap
Garden Pass
6665
Red Hills
Mt Callaghan
ROBERTS VALLEY
BOULDER VALLEY
CRESCENT
CORTEZ
DRY HILLS
SOUTHERN PACIFIC
WESTERN PACIFIC
River
Pine
Pony
Indian
Thomas
Robinson
Horse Cr
Henderson
Roberts Cr
45
46
47
48
49
51
52
53
54
55
E U R E K A
D E R



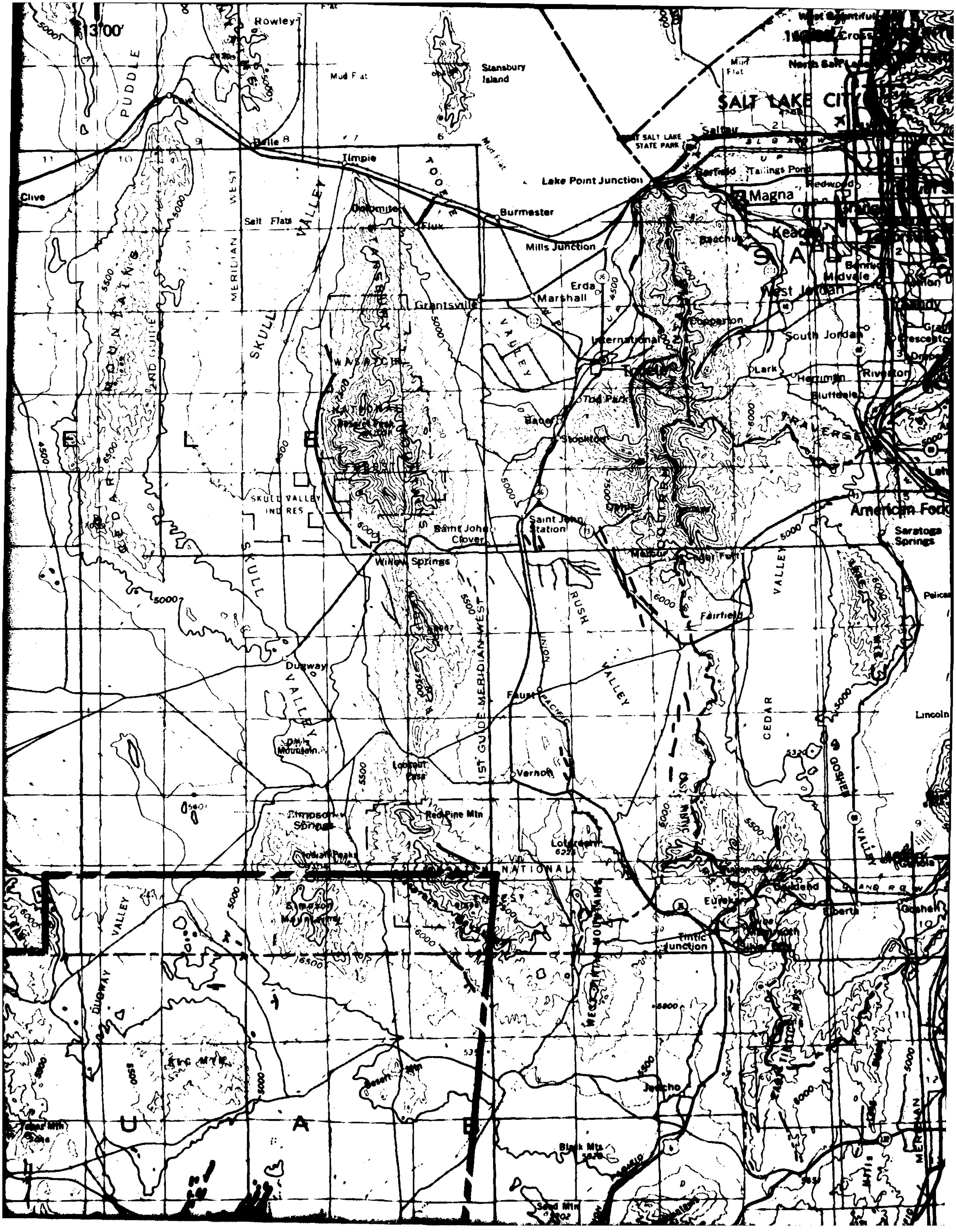
Elko
Elburz
Elko Mtn
Grindstone Mtn
White Flats
SOUTH FORK IND RES
Dixie Flats
Tobar
GLOVER
VALLEY
Chase Spr
Lamoille
HUMBOLDT
NATIONAL
FOREST
Arthur
6TH STANDARD PARALLEL
Valley Mtn
Lone Butte
Spruce Mtn
Lower Boone Spr
Dry Lake Flat
Squaw Mtn
Cedar Ridge
Jiggs
Robinson Mtn
FRANKLIN LAKE
Delcer Buttes
West Buttes
Palomino Ridge
Ruby Valley
RUBY VALLEY
Sharp
Currie
Currie Hills
Bald
High Bald Peak
RUBY LAKE
NATIONAL
WILDLIFE REFUGE
Mt Taylor
Goshute Lake
5TH STANDARD
Little Bald Mtn
Cherry Creek
Lovell Pk
Warm Springs
5TH STANDARD PARALLEL
54
55
56
57
58
59
60
61
62
63
64
65



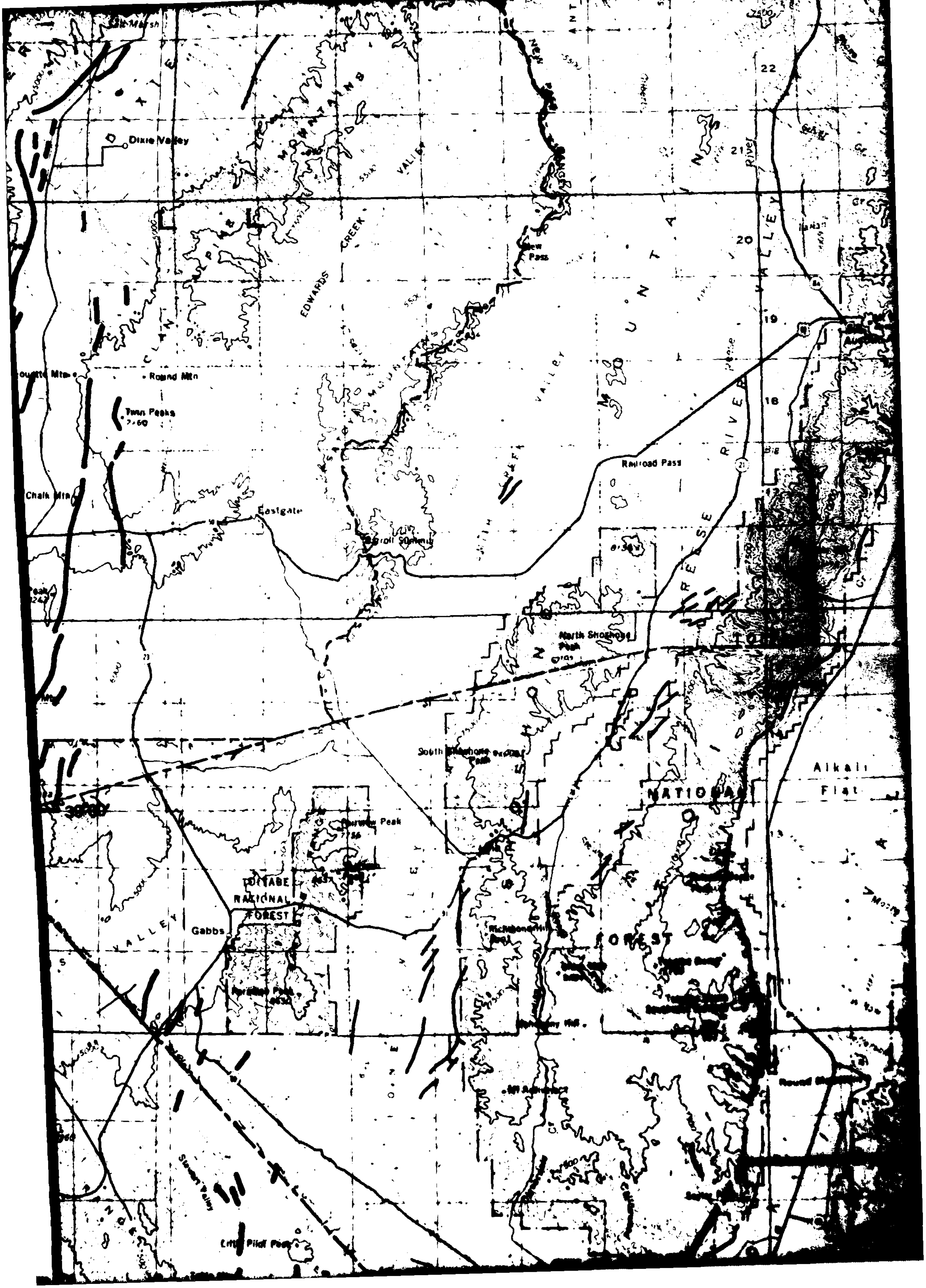
114°00'
Great Salt Lake Desert
Floating Island
Proctor
Silver Zone Pass
Shafter
Coshute
NORTHERN
WESTERN
PACIFIC
NEVADA
SALT
SALT LAKE
BASE
LINE
Bonneville Speedway
Bonneville Salt Flats
Leppy Peak
6698
Wendover
Salduro
Arinosa
WESTERN PACIFIC
Bonneville
TOANO
VALLEY
STEPTOE
Decoy
Great Salt Lake Desert
3RD GUIDE MERIDIAN WEST
Lower Boone Spr
Wildcat Peak
Goshute Peak
Ferguson Mts
7695
GOSHUTE
LAKE
TO
1ST STANDARD
PARALLEL
SOUTH
Creek
Sharp Peak
Bald Peak
White Horse Pass
White Horse Flat
Sugar Loaf Peak
8029
MOUNTAINS
ANTELOPE
Dutch Mtn
Currie Hills
Ochre Mtn
Clifton Hills
DESERT
STANDARD PARALLEL
Ibapah
VALLEY
Becky Peak
GOSHUTE
INDIAN
RESERVATION
Rocky Peak
Callao
2ND STANDARD PARALLEL SOUTH
Tippett
Trout Creek
KERN
Red Hills
FISH
SPRING
FLAT
Partoun
4230
4225
4254
4235
5000
4500

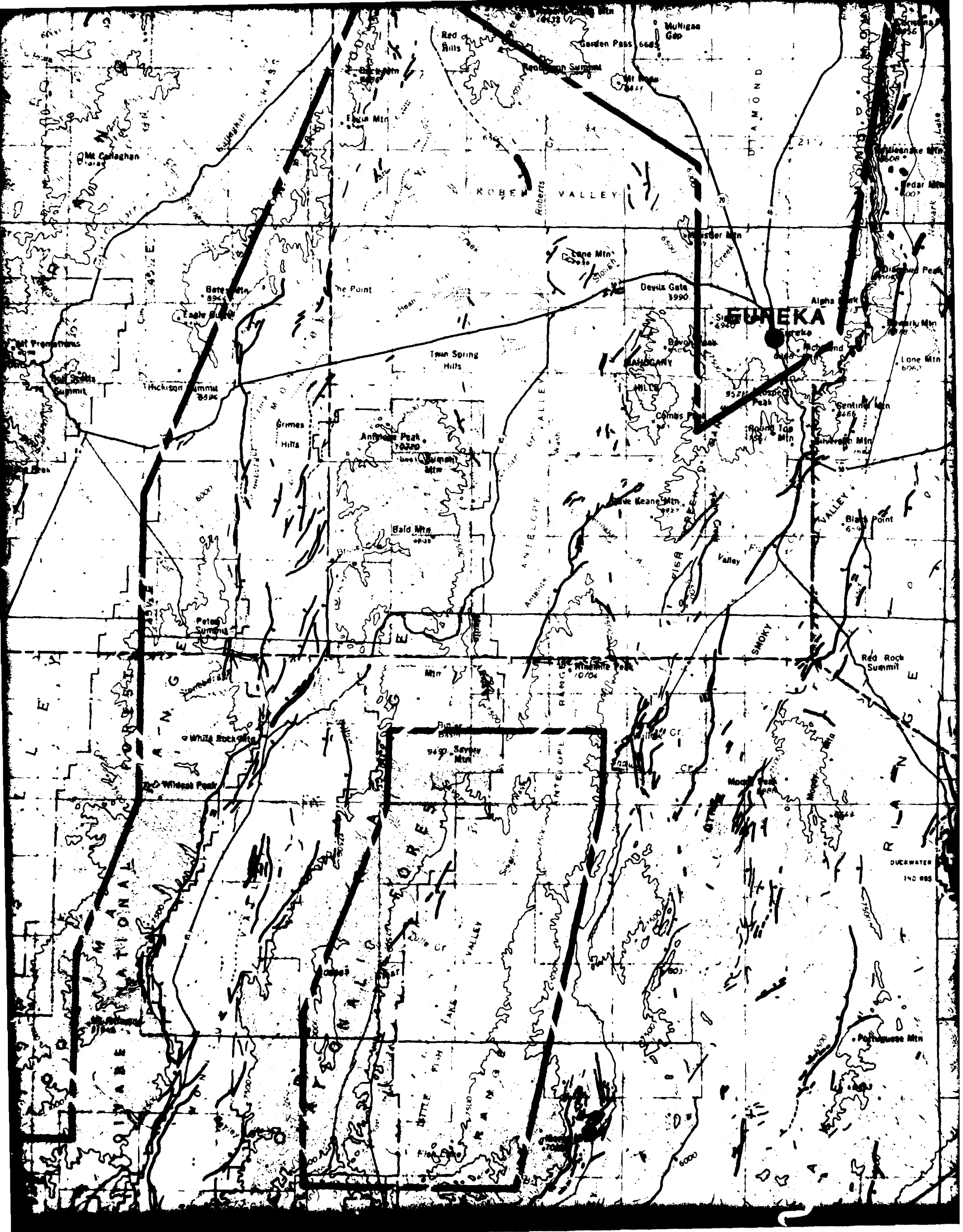


Rowley
Stansbury Island
Mud Flat
PUDDLE
LINE
Knolls
Clive
Timpie
Burmester
Lake Point Junction
Mills Junction
Erda
Marshall
Grantsville
International
Salt Flats
3RD GUIDE MERIDIAN WEST
2ND GUIDE MERIDIAN WEST
1ST GUIDE MERIDIAN WEST
SKULL VALLEY
SKULL VALLEY IND RES
Wildcat Mtn
O O E L E
Bauer
Stockton
Saint John
Saint John Station
Clover
Willow Springs
RUSH VALLEY
Fairfield
Dugway
Faust
Vernon
Lookout Pass
Red Pine Mtn
Simpson Springs
Simpson Mountains
NATIONAL
Eureka
Tintic Junction
Jericho
FISH SPRINGS
FISH SPRINGS FLAT
DUGWAY
VALLEY
U A B
Desert Mtn
Black Mts
Sand Mtn
Mud Flat
SALT

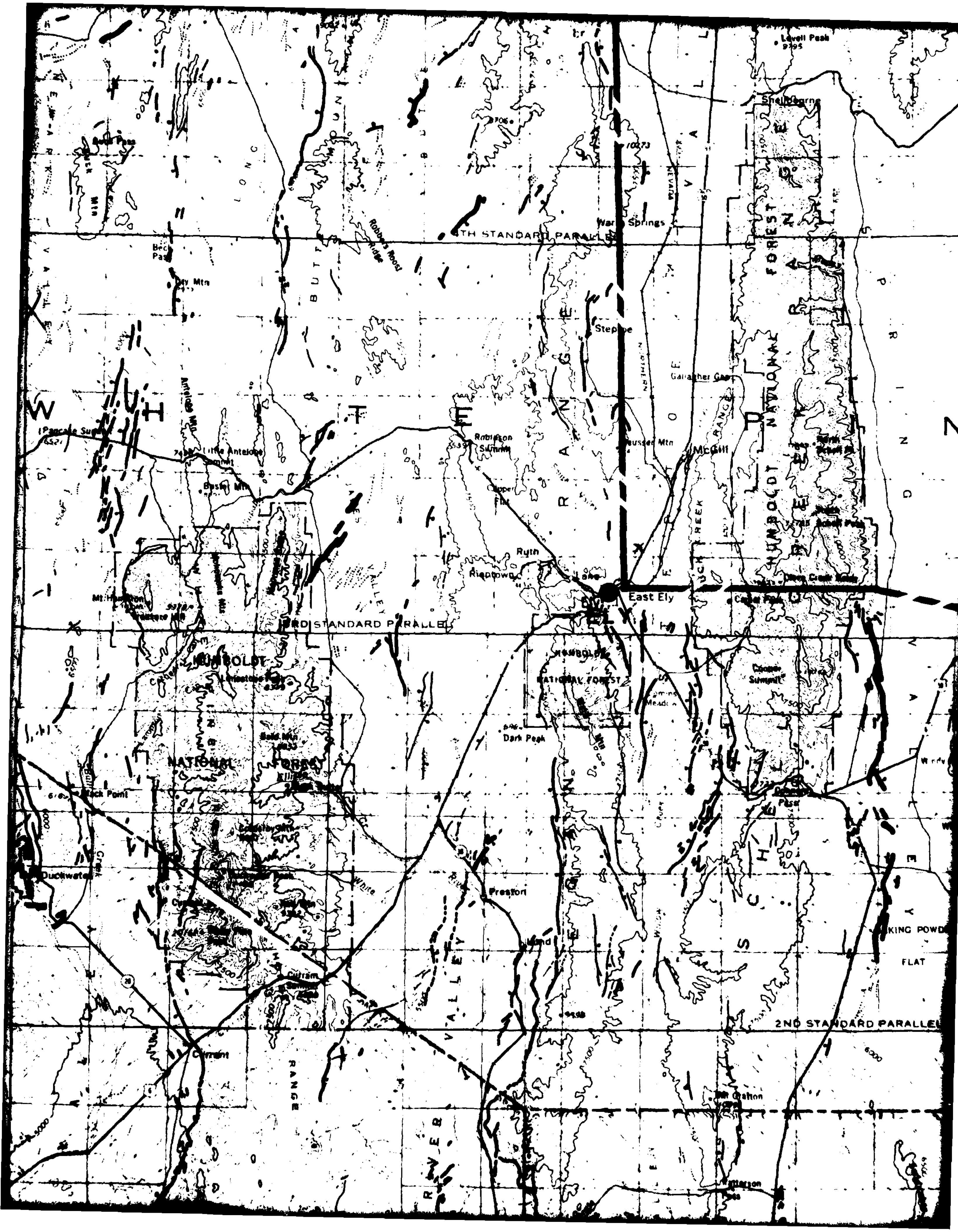


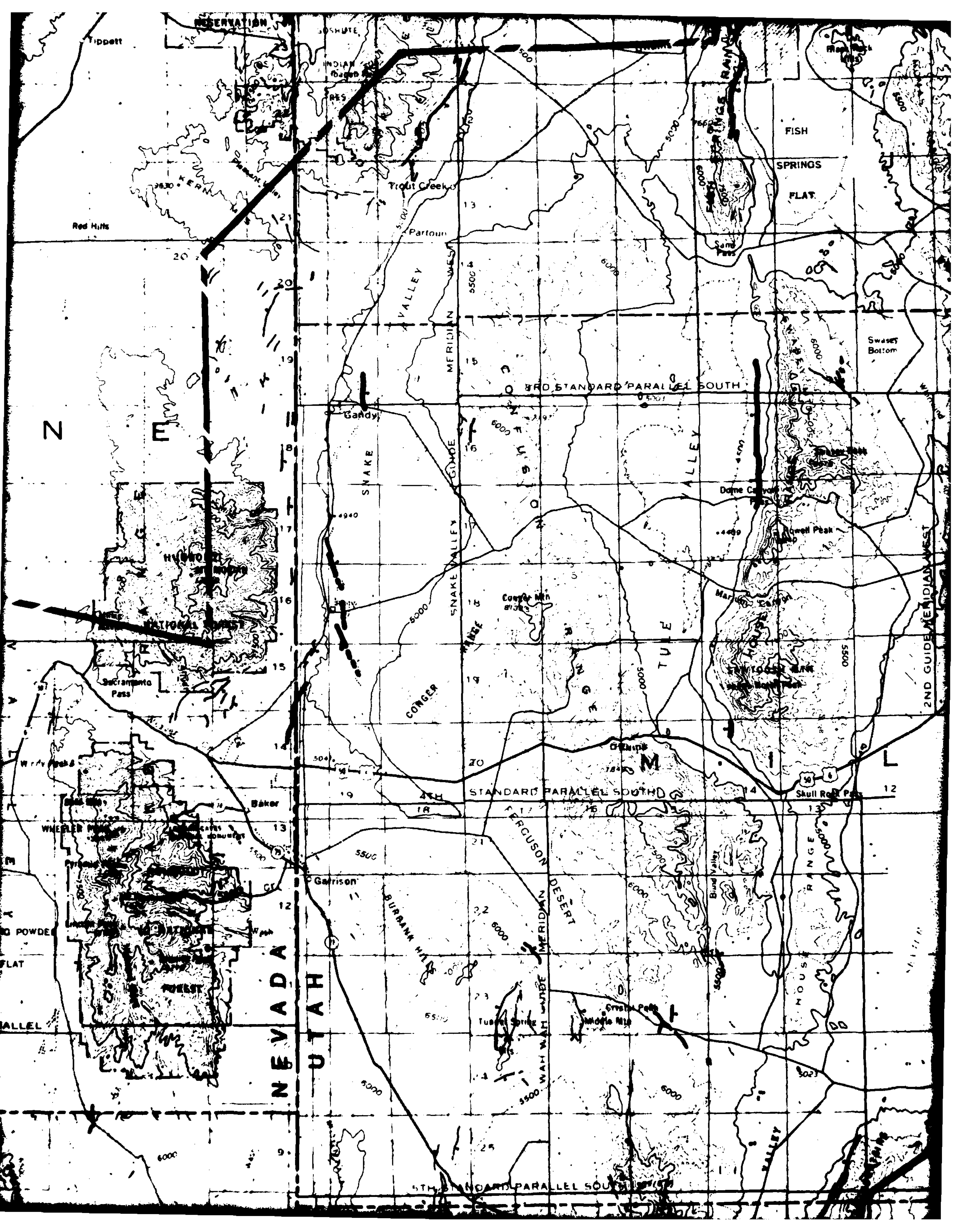
Rowley
Stansbury Island
Mud Flat
PUDDLE
SALT LAKE CITY
Saltair
Lake Point Junction
Clive
Timpie
Burmester
Salt Flats
Dolomite
Flux
Mills Junction
Magna
Garfield
Tailings Pond
Redwood
Kearns
Midvale
West Jordan
Sandy
Erda
Marshall
Grantsville
International
Tooele
Copperton
South Jordan
Lark
Herriman
Riverton
Bluffdale
Stockton
SKULL VALLEY IND RES
SKULL VALLEY
Saint John Station
Saint John
Clover
Willow Springs
Dugway
Fairfield
American Fork
Saratoga Springs
Lincoln
Faust
RUSH VALLEY
CEDAR VALLEY
1ST GUIDE MERIDIAN WEST
Vernon
Lookout Pass
Red Pine Mtn
Simpson Springs
Simpson Mountains
NATIONAL
Lofgreen
Eureka
Tintic Junction
Elberta
Goshen
Jericho
Black Mts
DUGWAY VALLEY


Salt Marsh
Dixie Valley
Round Mtn
Twin Peaks
Chalk Mtn
Eastgate
EDWARDS
CREEK
VALLEY
New Pass
Railroad Pass
RIVER
North Shoshone Peak
South Shoshone Peak
NATIONAL
Alkali
Flat
TOIYABE
NATIONAL
FOREST
Gabbs
FOREST
Little Pilot Peak
22
21
20
19
18

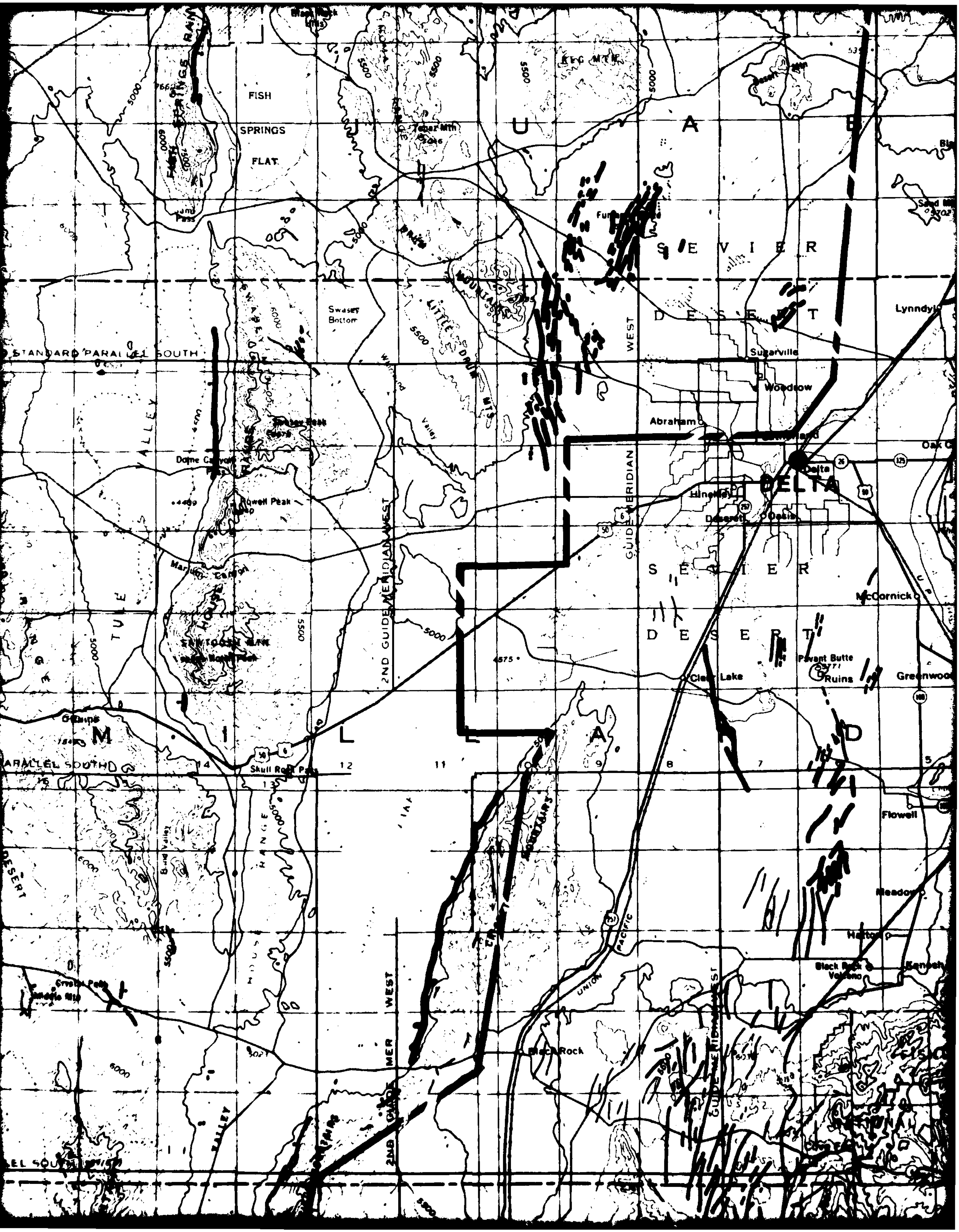


Mulligan Gap
Garden Pass
Red Hills
Mt Callaghan
Bates Mtn
8944
Eagle Butte
The Point
ROBER VALLEY
Roberts
Lone Mtn
Devils Gate
5990
EUREKA
Eureka
Richmond
Diamond Peak
Alpha Peak
Cedar Mtn
Lone Mtn
Twin Spring Hills
MAHOGANY HILLS
Combs Peak
Prospect Peak
Round Top Mtn
Sentinel Mtn
Grimes Hills
Antelope Peak
Summit Mtn
Bald Mtn
Dave Keane Mtn
Valley
VALLEY
Black Point
ANTELOPE VALLEY
SMOKY
Red Rock Summit
White Rock Mtn
Wildcat Peak
Savory Mtn
Moody Peak
DUCKWATER IND RES
Portuguese Mtn
6000
7500

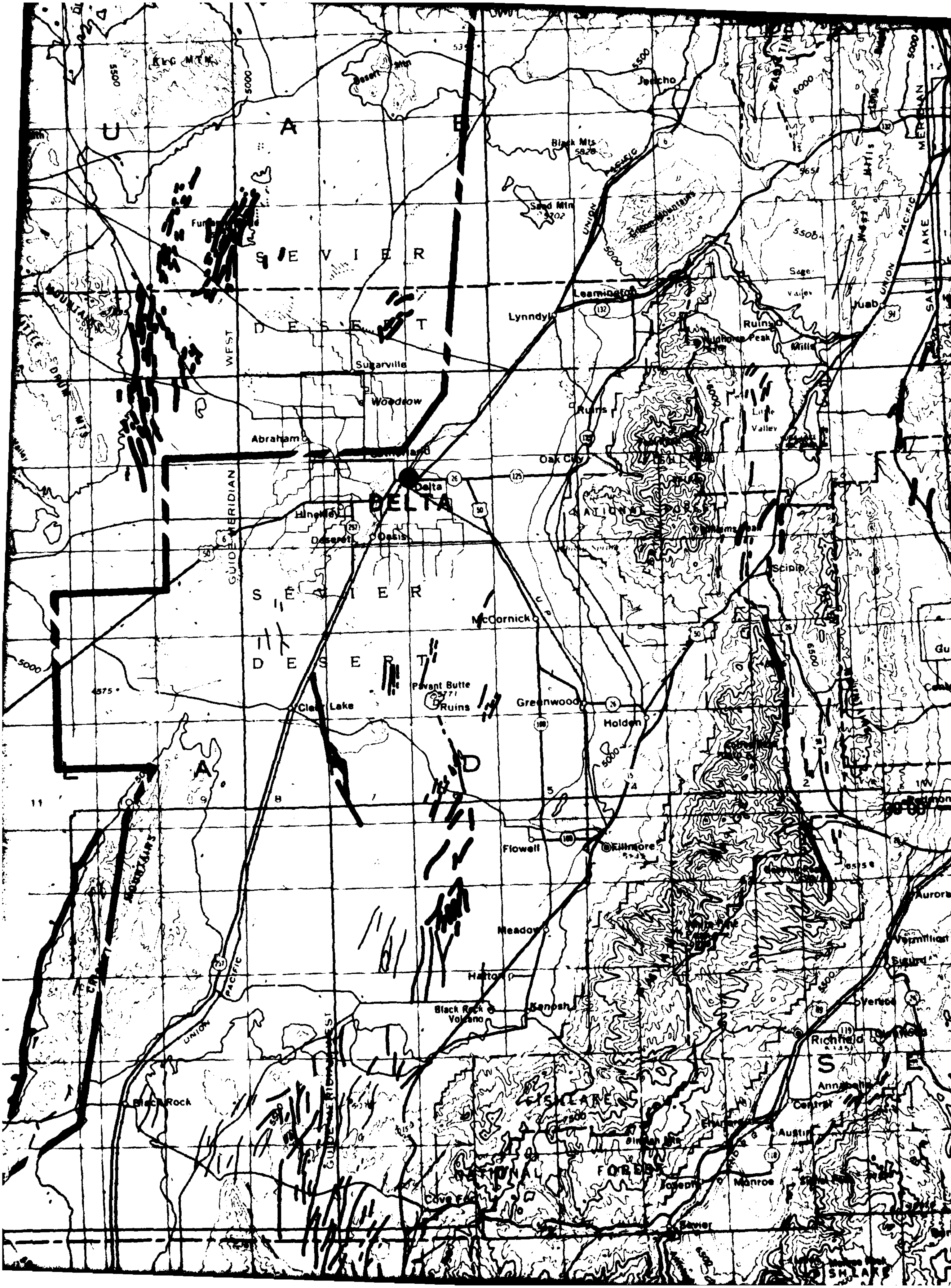

Lovell Peak
Warm Springs
4TH STANDARD PARALLEL
Robbers Roost Ridge
Steptoe
Gallagher Gap
Robinson Summit
McGill
Ruth
East Ely
3RD STANDARD PARALLEL
HUMBOLDT
NATIONAL FOREST
Cooper Summit
Dark Peak
Preston
Lund
Currant
RANGE
2ND STANDARD PARALLEL
FLAT
Duckwater
Little Antelope Summit
Bald Mtn



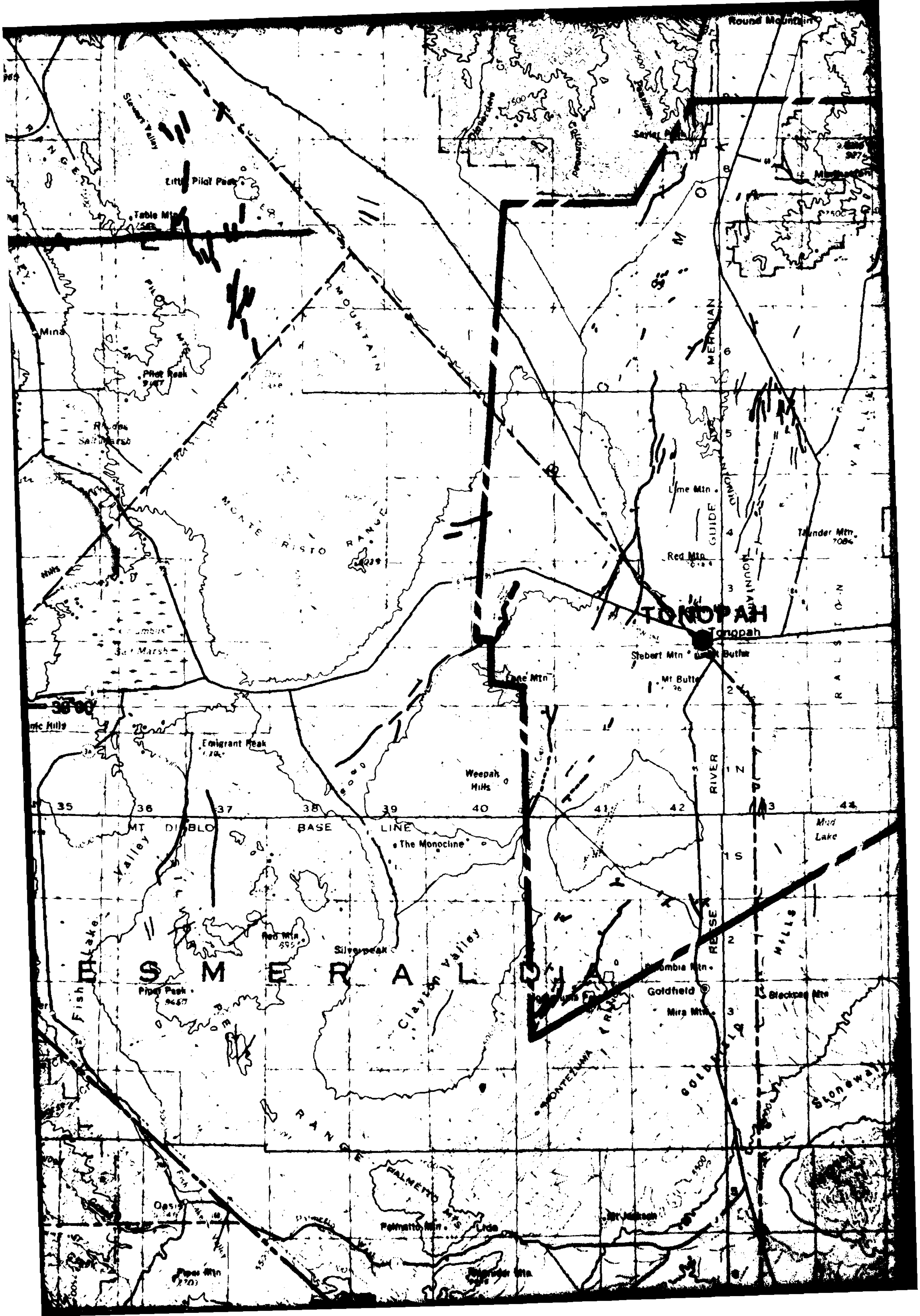
RESERVATION
GOSHUTE
Tippett
INDIAN
RES
FISH
SPRINGS
FLAT
Trout Creek
Partoun
Red Hills
KERN
Sand Pass
VALLEY
MERIDIAN
WEST
Swasey Bottom
3RD STANDARD PARALLEL SOUTH
Gandy
SNAKE
Dome Canyon Pass
Howell Peak
TULE
VALLEY
SNAKE VALLEY GUIDE
Conger Mtn
CONGER
RANGE
Marjum Canyon
HOUSE
2ND GUIDE MERIDIAN WEST
NATIONAL FOREST
Sacramento Pass
Baker
4TH STANDARD PARALLEL SOUTH
Skull Rock Pass
WHEELER PEAK
Garrison
FERGUSON
DESERT
BURBANK HI
MERIDIAN
WAH WAH
Tunnel Spring
Crystal Peak
Middle Mtn
RANGE
HOUSE
NEVADA
UTAH
FOREST
POWDER
FLAT
ALLEL
VALLEY
5TH STANDARD PARALLEL SOUTH
N
E
M
L



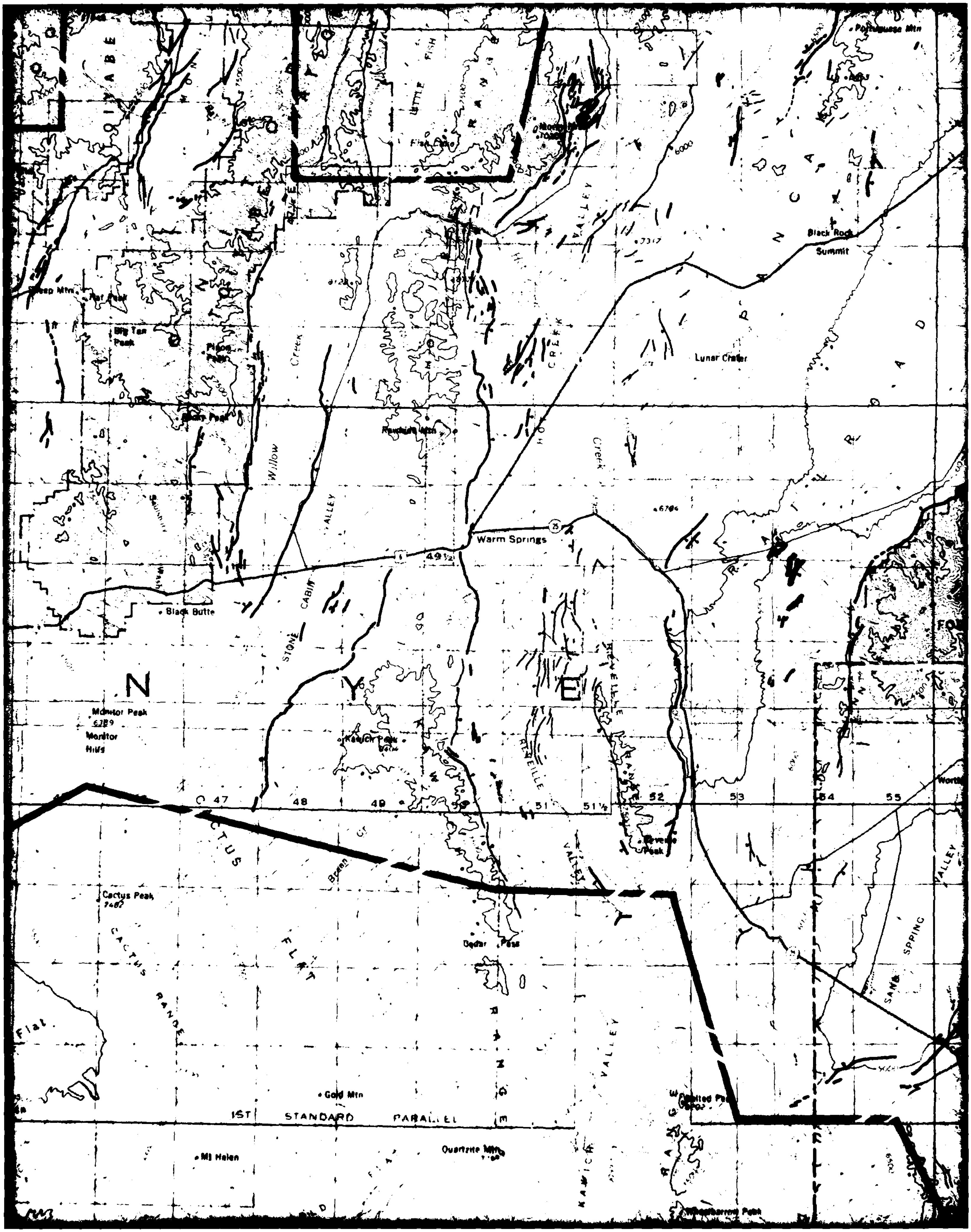
FISH
SPRINGS
FLAT
J U A B
S E V I E R
D E S E R T
Swasey
Bottom
STANDARD PARALLEL SOUTH
WEST
Sugarville
Woodrow
Abraham
Lynndyl
Oak C
Delta
DELTA
Hinckley
Deseret
Oasis
GUIDE MERIDIAN
2ND GUIDE MERIDIAN WEST
Dome Canyon Pass
Rowell Peak
Marjum Canyon
TULE
VALLEY
S E V I E R
D E S E R T
McCornick
Pavant Butte
Ruins
Clear Lake
Greenwood
M I L L A R D
Skull Rock Pass
Flowell
Meadow
Hatton
Black Rock Volcano
Kanosh
UNION
PACIFIC
Black Rock
GUIDE MERIDIAN WEST
5000
5500



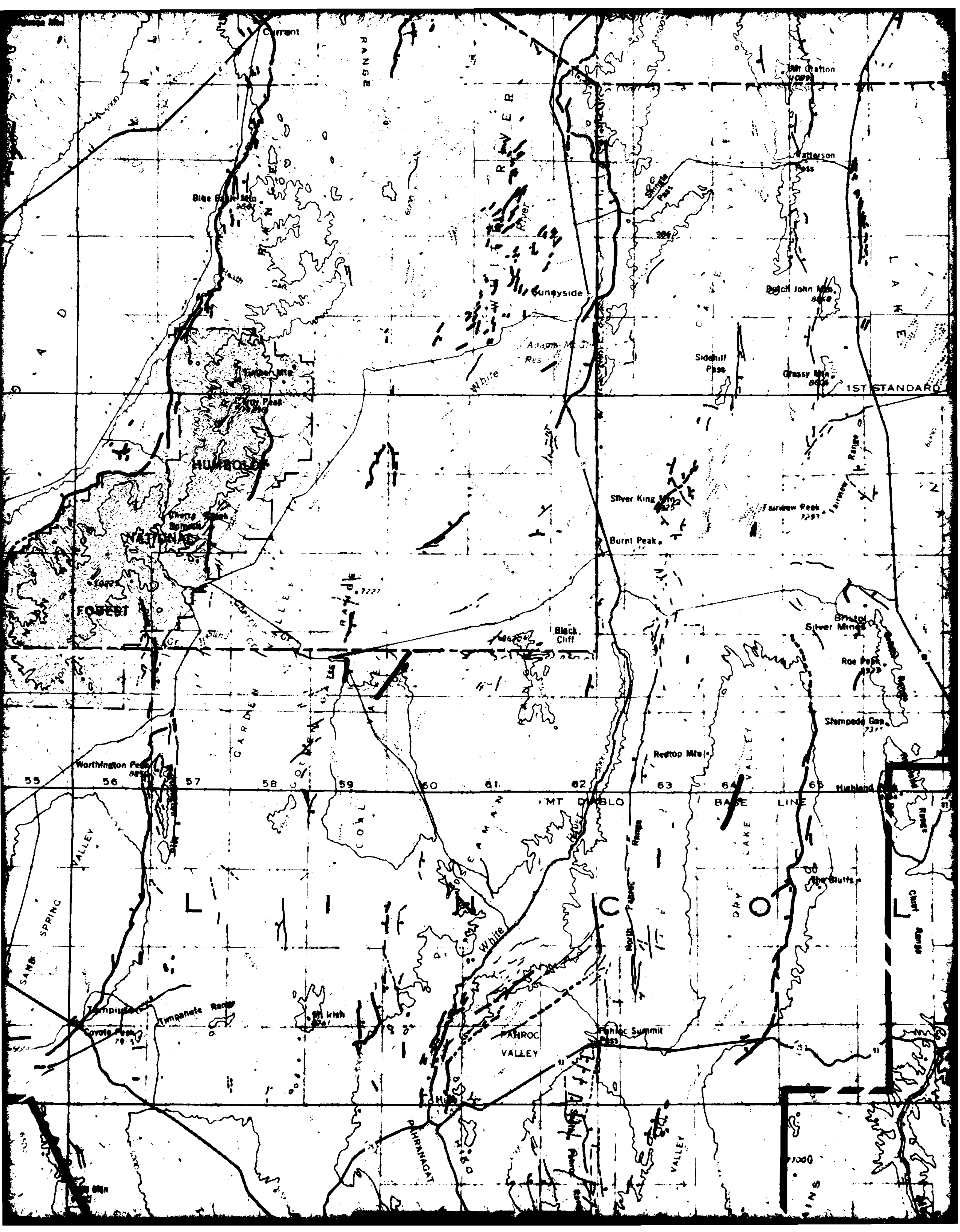
U A B
SEVIER
DESERT
Jericho
Black Mts
Sand Mtn
Sugarville
Woodrow
Abraham
Sutherland
Delta
DELTA
Hinckley
Deseret
Oasis
Lynndyl
Leamington
Oak City
McCornick
Pavant Butte
Ruins
Clear Lake
Greenwood
Holden
Flowell
Fillmore
Meadow
Hatton
Kanosh
Black Rock Volcano
Black Rock
Cove Fort
Scipio
Juab
Mills
Little Valley
Aurora
Vermillion
Sigurd
Venice
Richfield
Central
Annabella
Austin
Elsinore
Joseph
Monroe
Sevier
FISHLAKE
NATIONAL
FOREST
GUIDE MERIDIAN
WEST
UNION PACIFIC



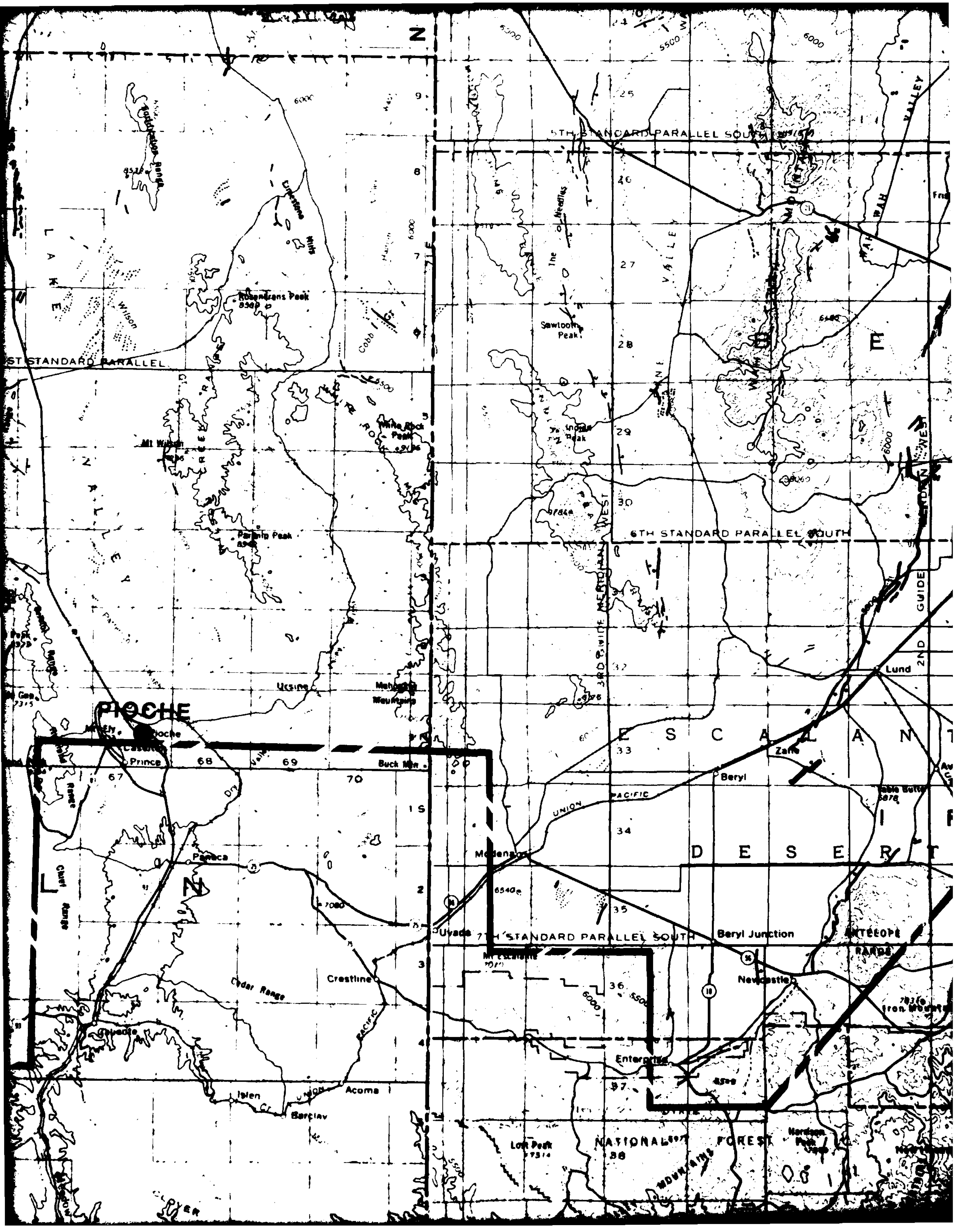
Round Mountain
Little Pilot Peak
Table Mtn
Mina
Pilot Peak
Rhodes Salt Marsh
MOUNTAIN
MONTE CRISTO RANGE
Columbus Salt Marsh
TONOPAH
Tonopah
Siebert Mtn
Mt Butler
Lone Mtn
Lime Mtn
Red Mtn
Thunder Mtn
GUIDE MERIDIAN
Emigrant Peak
Weepah Hills
35
36
37
38
39
40
41
42
43
44
MT DIABLO BASE LINE
The Monocline
Mud Lake
Fish Lake Valley
Red Mtn
Silverpeak
E S M E R A L D A
Clayton Valley
Pilot Peak
Columbia Mtn
Goldfield
Blackcap Mtn
Mira Mtn
Montezuma Peak
MONTEZUMA RANGE
GOLDFIELD
Stonewall
RANGE
PALMETTO MTS
Palmetto Mtn
Lida
Oasis
Piper Mtn
REESE RIVER
HILLS
RALSTON VALLEY
MONITOR



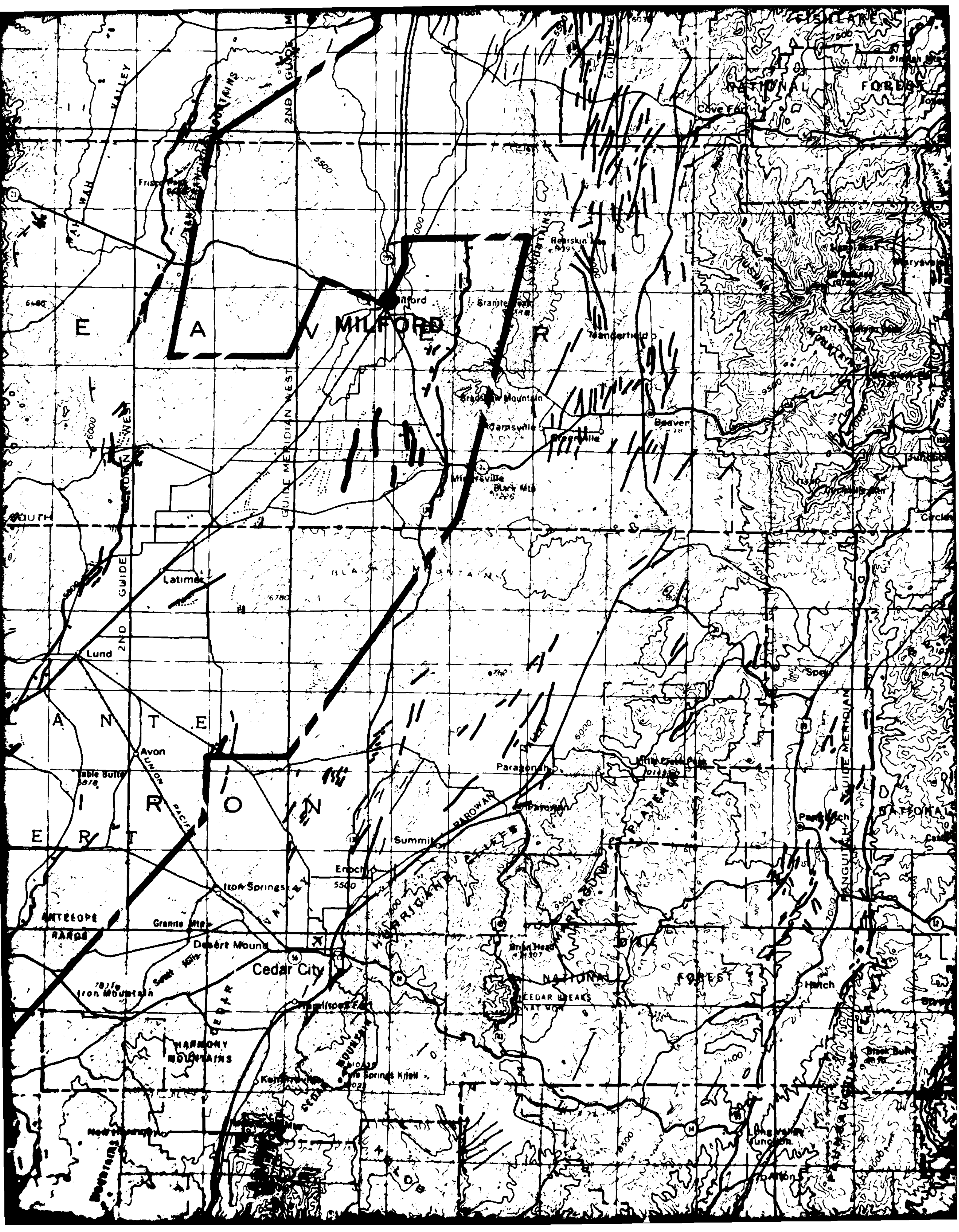
Portuguese Mtn
LITTLE
FISH
Fish Lake
VALLEY
Black Rock
Summit
Lunar Crater
Sheep Mtn
Big Ten Peak
Pinon Peak
Willow
Creek
Reveille Mtn
CREEK
Creek
STONE CABIN
VALLEY
Warm Springs
49½
Black Butte
N
Y
E
Monitor Peak
6389
Monitor Hills
Kawich Peak
REVEILLE
47
48
49
51
51½
52
53
54
55
Reveille Peak
Cactus Peak
CACTUS RANGE
FLAT
Cedar Pass
KAWICH
VALLEY
Flat
Gold Mtn
1ST STANDARD PARALLEL
Mt Helen
Quartzite Mtn
SAND SPRING
VALLEY



Currant
RANGE
Mt Grafton
Patterson Pass
Sunnyside
White
River
Timber Mtn
HUMBOLDT
NATIONAL
FOREST
Silver King Mtn
Fairview Peak
Burnt Peak
Butch John Mtn
Sidehill Pass
Grassy Mtn
1ST STANDARD
Black Cliff
Bristol Silver Mines
Roe Peak
Stampede Gap
Redtop Mtn
Worthington Peak
55
56
57
58
59
60
61
62
63
64
65
MT DIABLO
BASE LINE
The Bluffs
SPRING
VALLEY
Tempiute
Coyote Peak
Timpahute Range
Mt Irish
PAHROC
VALLEY
Pahroc Summit Pass
PAHRANAGAT
VALLEY
L
I
N
C
O
L



PIOCHE
Pioche
Castleton
Prince
Panaca
Caliente
Islen
Acoma
Barclay
Crestline
Uvada
Modena
Beryl
Beryl Junction
Zane
Lund
Newcastle
Enterprise
Ursine
Buck Mtn.
Mt Wilson
Rosencrans Peak
Parsnip Peak
White Rock Peak
Sawtooth Peak
Indian Peak
Mt Escalante
Lone Peak
Table Butte
Iron Mountain
Cedar Range
Chief Range
Limestone Hills
ANTELOPE RANGE
ESCALANTE
DESERT
NATIONAL FOREST
UNION PACIFIC
5TH STANDARD PARALLEL SOUTH
6TH STANDARD PARALLEL SOUTH
7TH STANDARD PARALLEL SOUTH
1ST STANDARD PARALLEL
3RD GUIDE MERIDIAN WEST
2ND GUIDE MERIDIAN WEST
VALLEY
WAH WAH VALLEY
LAKE VALLEY



MILFORD
Milford
Granite Peak
Cove Fort
NATIONAL FOREST
Bearskin Mtn
Frisco Peak
2ND GUIDE
GUIDE MERIDIAN WEST
Bradshaw Mountain
Greenville
Beaver
Minersville
Black Mtn
SOUTH
Latimer
BLACK MOUNTAIN
Lund
2ND GUIDE
Avon
Table Butte
UNION PACIFIC
Paragonah
Parowan
Summit
Enoch
Iron Springs
ANTELOPE RANGE
Granite Mtn
Desert Mound
Cedar City
Iron Mountain
Hamilton Fort
HARMONY MOUNTAINS
CEDAR BREAKS
NATIONAL
FOREST
Brian Head
Hatch
Panguitch
Junction
Circleville
Marysvale
Long Valley Junction
Alton
E
A
V
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R
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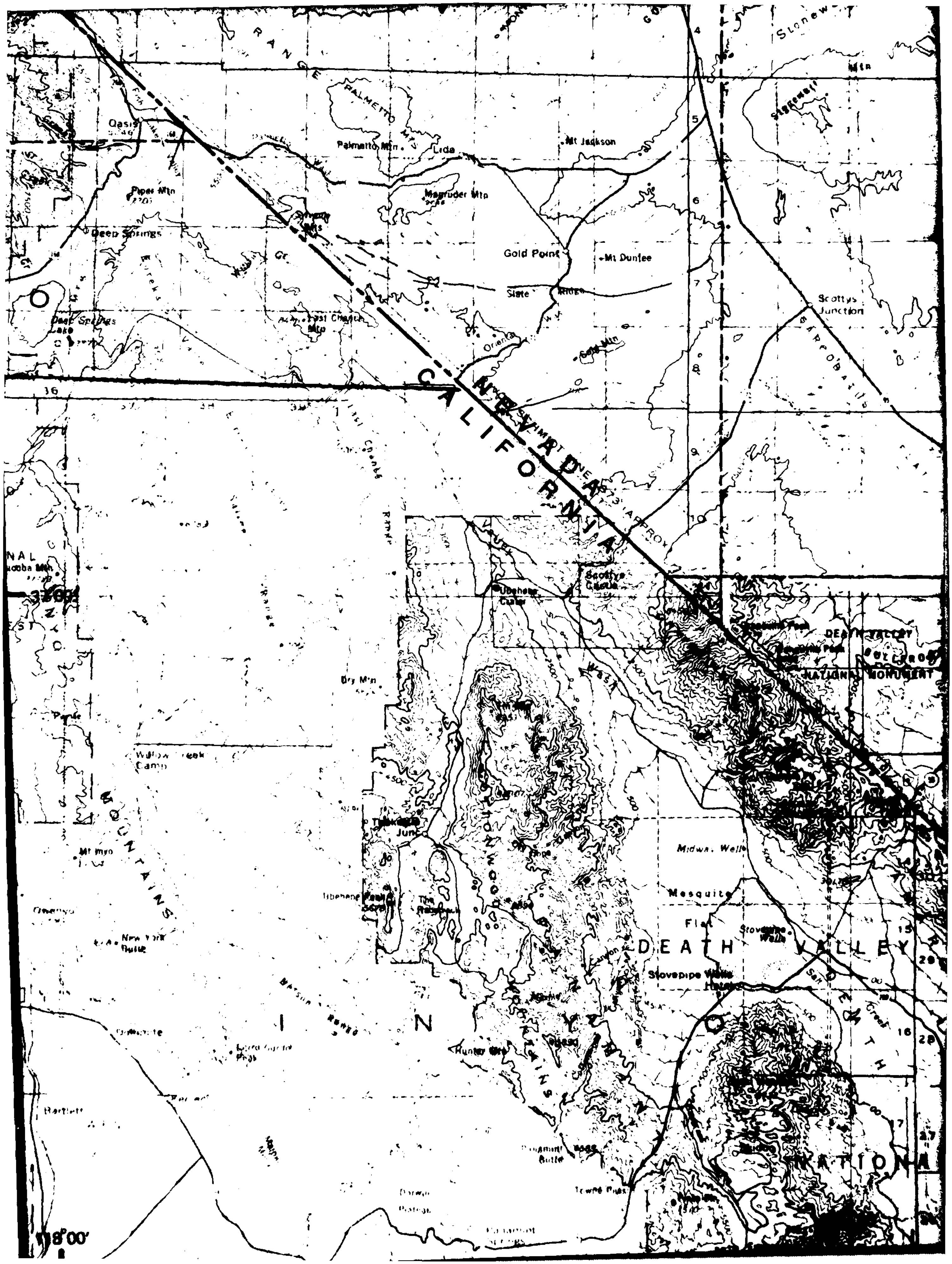
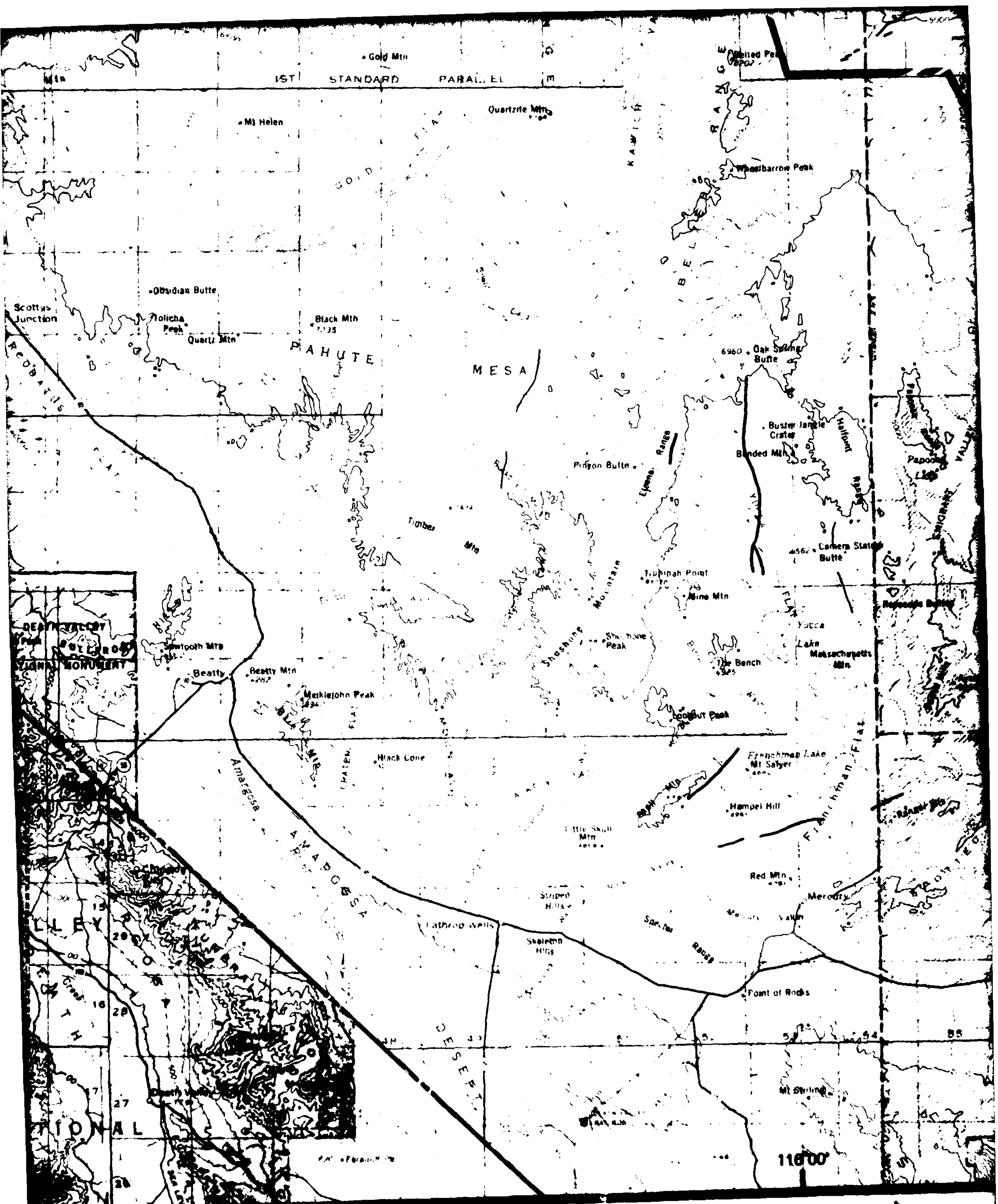
R
O
N
E
R
T

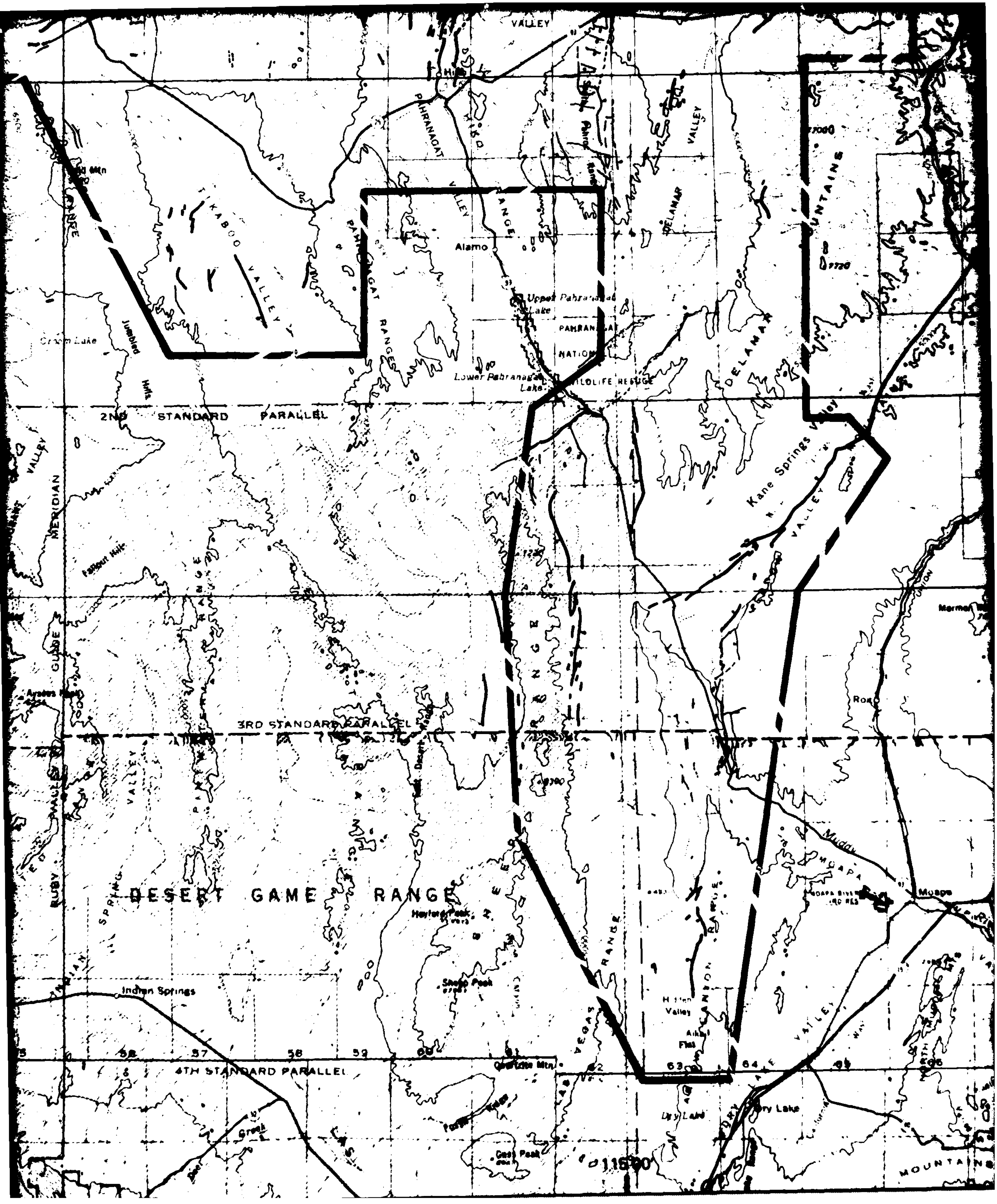
Black Rock
Elsinore
Austin
NATIONAL
FOREST
Joseph
Monroe
Cove Fort
Sevier
Monroe Peak
Marysvale
NATIONAL FOREST
Thompsonville
Alunite
Milford
MILFORD
Manderfield
Beaver
Adamsville
Greenville
Minersville
Black Mtn
Junction
Kingston
Circleville
Table Mountain
Antimony
BLACK MOUNTAIN
Spry
MERIDIAN
Paragonah
Little Creek Peak
Parowan
PAROWAN
PLATEAU
Panguitch
DIXIE
NATIONAL
FOREST
Summit
Enoch
Brian Head
NATIONAL
FOREST
Hatch
Rubys Inn
Tropic
Bryce Canyon
CEDAR BREAKS
BRYCE CANYON
NATIONAL MONUMENT
Cannonville
Kodachrome
Long Valley Junction
Alton
VALLEY



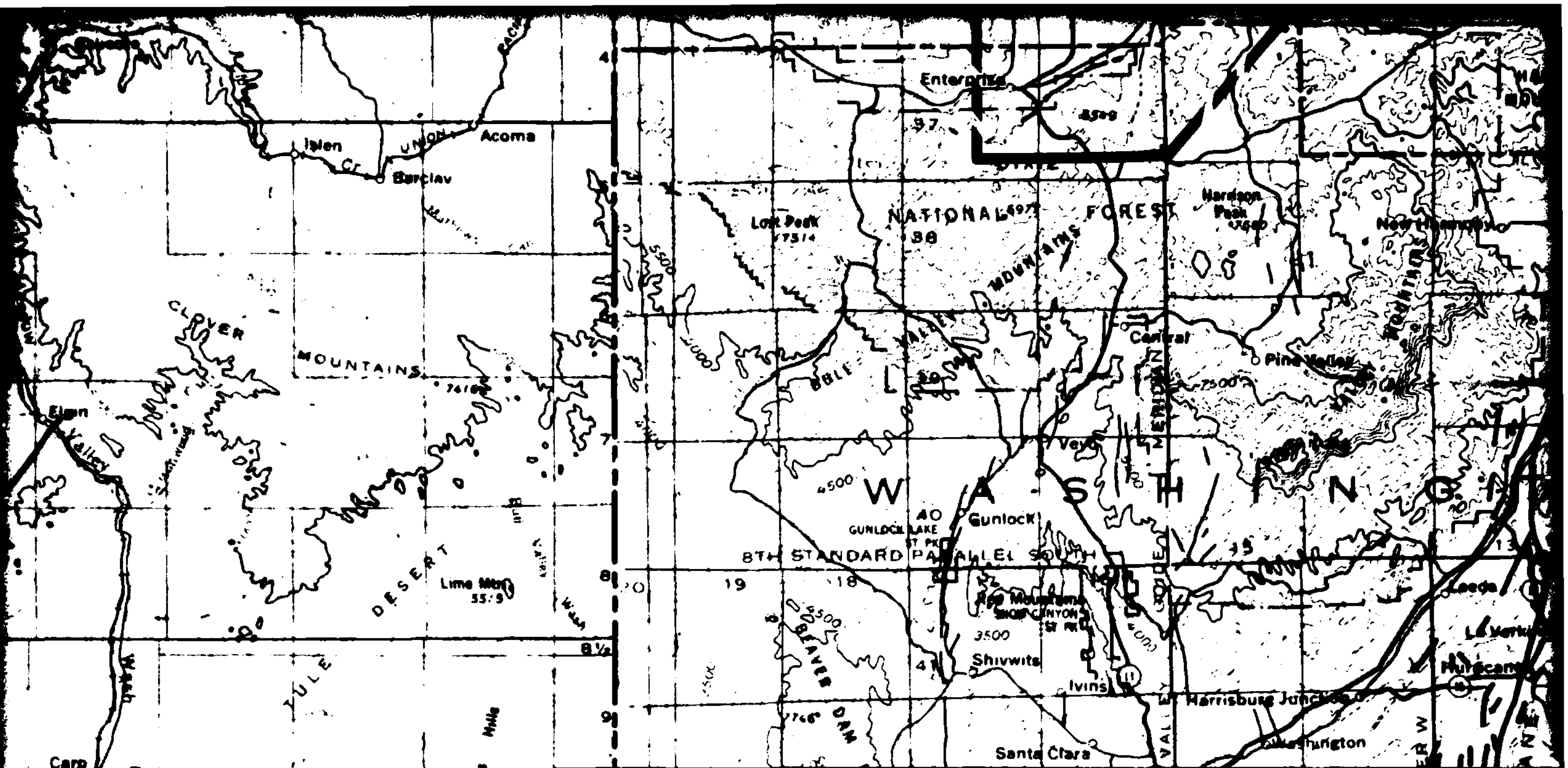
RANGE
PALMETTO
Palmetto Mtn
Lida
Mt Jackson
Oasis
Piper Mtn
Magruder Mtn
Deep Springs
Gold Point
Mt Dunfee
Slate Ridge
Deep Springs Lake
Last Chance Mtn
Scottys Junction
Oriental
NEVADA
CALIFORNIA
Scottys Castle
Ubehebe Crater
DEATH VALLEY
NATIONAL MONUMENT
Dry Mtn
Willow Creek Camp
MOUNTAINS
Mt Inyo
Teakettle Jun
Ubehebe Peak
The Racetrack
Midway Well
Mesquite
Flat
Stovepipe Wells
DEATH VALLEY
Stovepipe Wells Hotel
New York Butte
I N
Hunter Mtn
Panamint Butte
Towne Pass
Darwin
Bartlett
118°00'

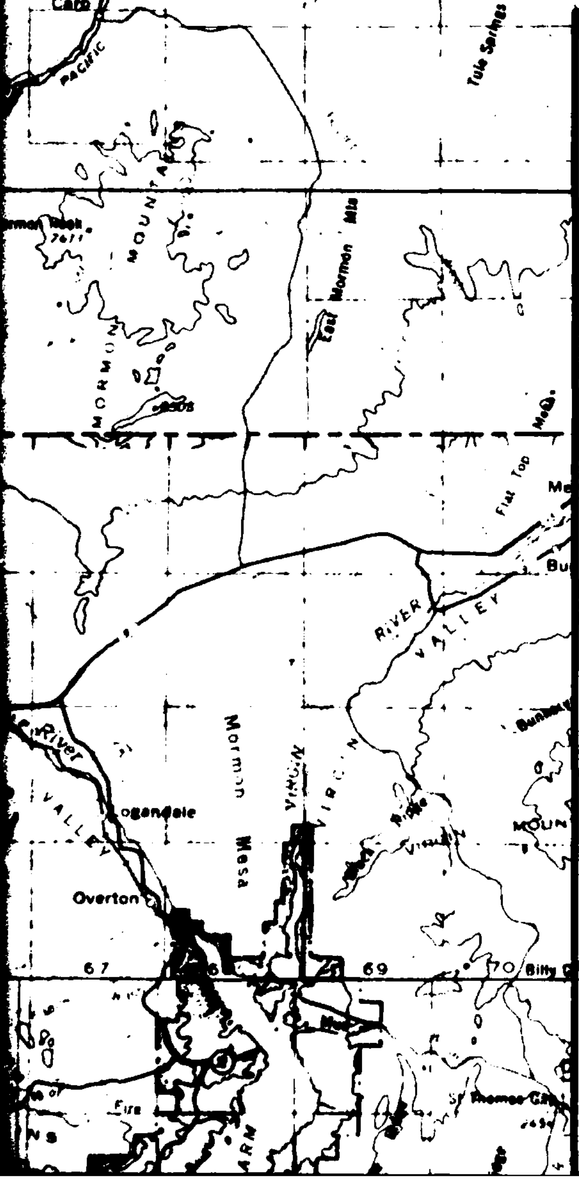


Gold Mtn
1ST STANDARD PARALLEL
Quartzite Mtn
Mt Helen
Wheelbarrow Peak
Obsidian Butte
Scottys Junction
Tolicha Peak
Quartz Mtn
Black Mtn
PAHUTE MESA
6960 Oak Spring Butte
Buster Jangle Crater
Banded Mtn
Halfpint Range
Pinyon Butte
Eleana Range
Timber Mtn
Camera Station Butte
Tippipah Point
Mine Mtn
Shoshone Mountain
Shoshone Peak
Yucca Lake
Massachusetts Mtn
The Bench
Sawtooth Mtn
Beatty
Beatty Mtn
Meiklejohn Peak
Lookout Peak
Black Cone
Frenchman Lake
Mt Salyer
Hampel Hill
Frenchman Flat
Amargosa
AMARGOSA DESERT
Little Skull Mtn
Red Mtn
Striped Hills
Mercury
Lathrop Wells
Skeleton Hills
Specter Range
Point of Rocks
Mt Stirling
116°00'



VALLEY
PAHRANAGAT
TIKABOO VALLEY
PAHRANAGAT RANGE
Alamo
Upper Pahranagat Lake
PAHRANAGAT NATIONAL WILDLIFE REFUGE
Lower Pahranagat Lake
DELAMAR
DELAMAR VALLEY
MOUNTAINS
2ND STANDARD PARALLEL
MERIDIAN
VALLEY
Jumbled Hills
Kane Springs Valley
3RD STANDARD PARALLEL
DESERT GAME RANGE
SPRING VALLEY
RUBY VALLEY
Hayford Peak
Sheep Peak
SHEEP RANGE
LAS VEGAS RANGE
Hidden Valley
Alkali Flat
Muddy
MOAPA
Moapa
Indian Springs
Quartzite Mtn
4TH STANDARD PARALLEL
57
58
59
60
61
62
63
64
65
Dry Lake
DRY LAKE VALLEY
Gass Peak
MOUNTAINS





NORTH

DATUM

EXPLANATION

FAULT: Tick mark is on down dropped side. Solid line indicates continuo portions of scarp are removed by erosion; dashed line indicates trace inferre scarps and (or) presence of lineaments between the scarps. Age of most rec

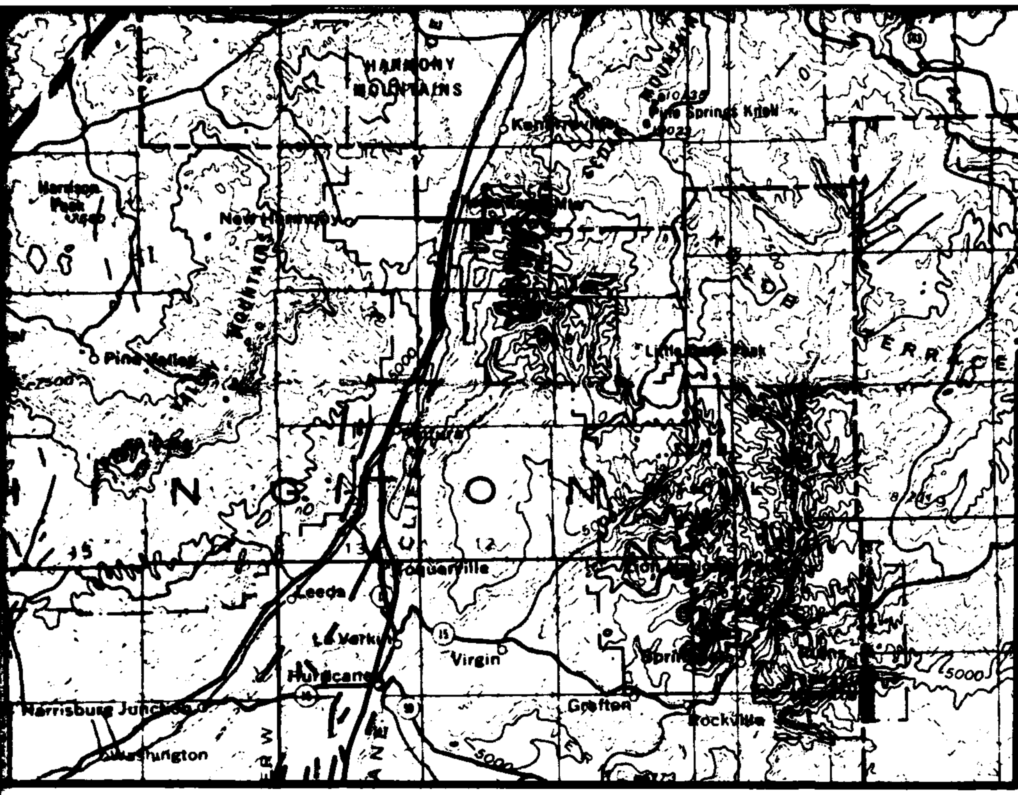
Post Bonneville and Lahontan Pluvial-Lake Highstand (≤

Pleistocene (≈ 15,000 years to 1.8 million years).

Indeterminate; late Tertiary or younger, probably Quate to lack of young stratigraphic units overlying the surface

LINEAMENT: Vegetation alignments and tonal contrasts without topogra

APPROXIMATE BOUNDARY OF FAULT STUDY REGION



SCALE 1:500,000

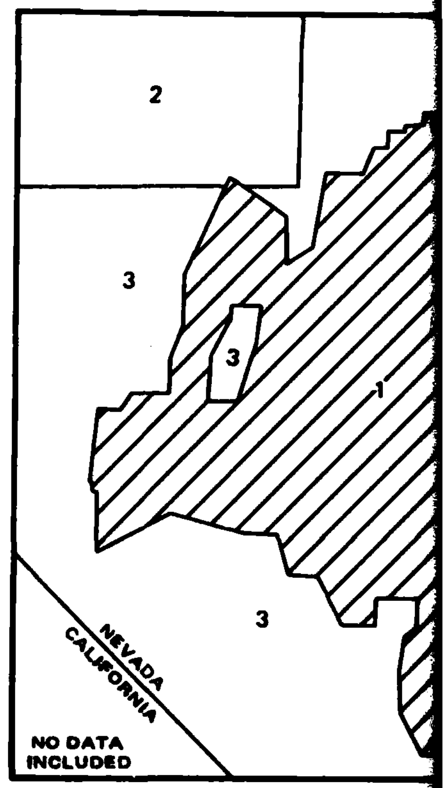
0 10 20

1INCH EQUALS APPROXIMATELY 8 MILES

0 10 20

DATUM IS MEAN SEA LEVEL CONTOUR INTERVAL 500 FEET

LOCATION DIAGRAM



EXPLANATION

pped side. Solid line indicates continuous fault scarp except for narrow drainage crossings where small sion; dashed line indicates trace inferred between more widely spaced scarps based on alignment of ts between the scarps. Age of most recent movement denoted by line width.

d Lahontan Pluvial-Lake Highstand (≤ 15,000 years).

00 years to 1.8 million years).

Tertiary or younger, probably Quaternary. Scarps are prominent but age cannot be determined due ratigraphic units overlying the surface trace of faults.

s and tonal contrasts without topographic relief; believed to be faults or fault-related cracks.

FAULT STUDY REGION

REFEREN

(1) AREA COVERED IN THIS REPORT.

(2) WALLACE, R.E., 1979, MAP OF YOU EARTHQUAKES IN NORTHERN-CENTR VEY OPEN FILE REPORT 79–1554, MA

(3) STEWART, J.H., AND CARLSON, J.E GEOLOGICAL SURVEY MAP, SCALE 1:

(4) ANDERSON, L.W., AND MILLER, D. MAP OF UTAH: FUGRO INC., AND UTA SURVEY, SCALE 1: 500,000.

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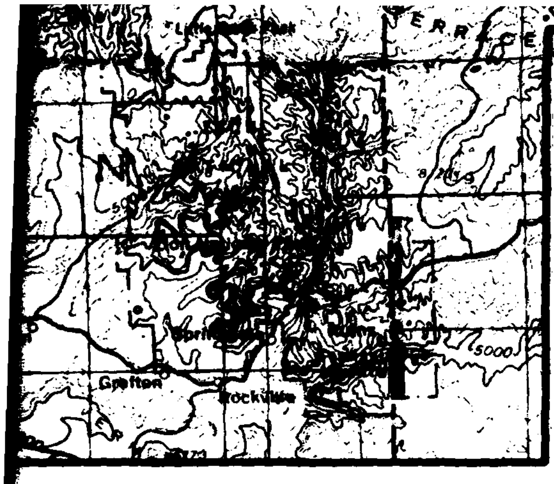
The Earth Technology Corporation

M
DEPA

MAP OF YOUNG FAUL
IN THE MX DEP
EAST-CENT
AND WEST-C

6 NOV 81



SCALE 1:500,000

10 20

EQUALS APPROXIMATELY 8 MILES

0 10 20

N SEA LEVEL CONTOUR INTERVAL 500 FEET

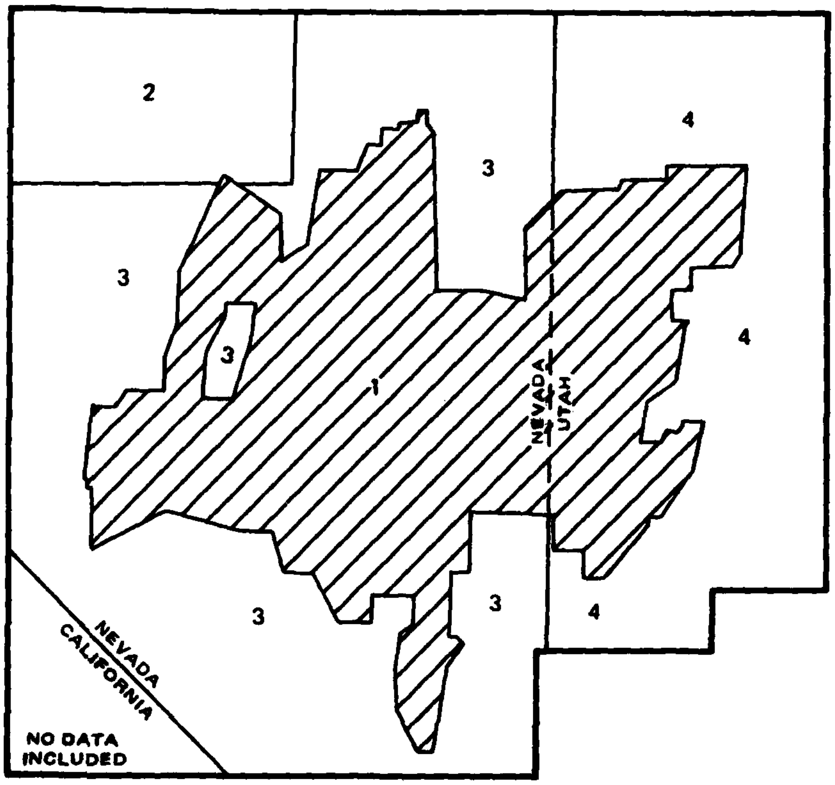
scarp except for narrow drainage crossings where small
en more widely spaced scarps based on alignment of
ement denoted by line width.

years).

carps are prominent but age cannot be determined due
faults.

ief; believed to be faults or fault-related cracks.

LOCATION DIAGRAM OF DATA SOURCES



REFERENCES

(1) AREA COVERED IN THIS REPORT.

(2) WALLACE, R.E., 1979, MAP OF YOUNG FAULT SCARPS RELATED TO EARTHQUAKES IN NORTHERN-CENTRAL NEVADA: U.S. GEOLOGICAL SURVEY OPEN FILE REPORT 79–1554, MAP SCALE 1: 125,000.

(3) STEWART, J.H., AND CARLSON, J.E., 1978, GEOLOGIC MAP OF NEVADA: U.S. GEOLOGICAL SURVEY MAP, SCALE 1: 500,000.

(4) ANDERSON, L.W., AND MILLER, D.G., 1979, QUATERNARY FAULT MAP OF UTAH: FUGRO INC., AND UTAH GEOLOGICAL AND MINERALOGICAL SURVEY, SCALE 1: 500,000.

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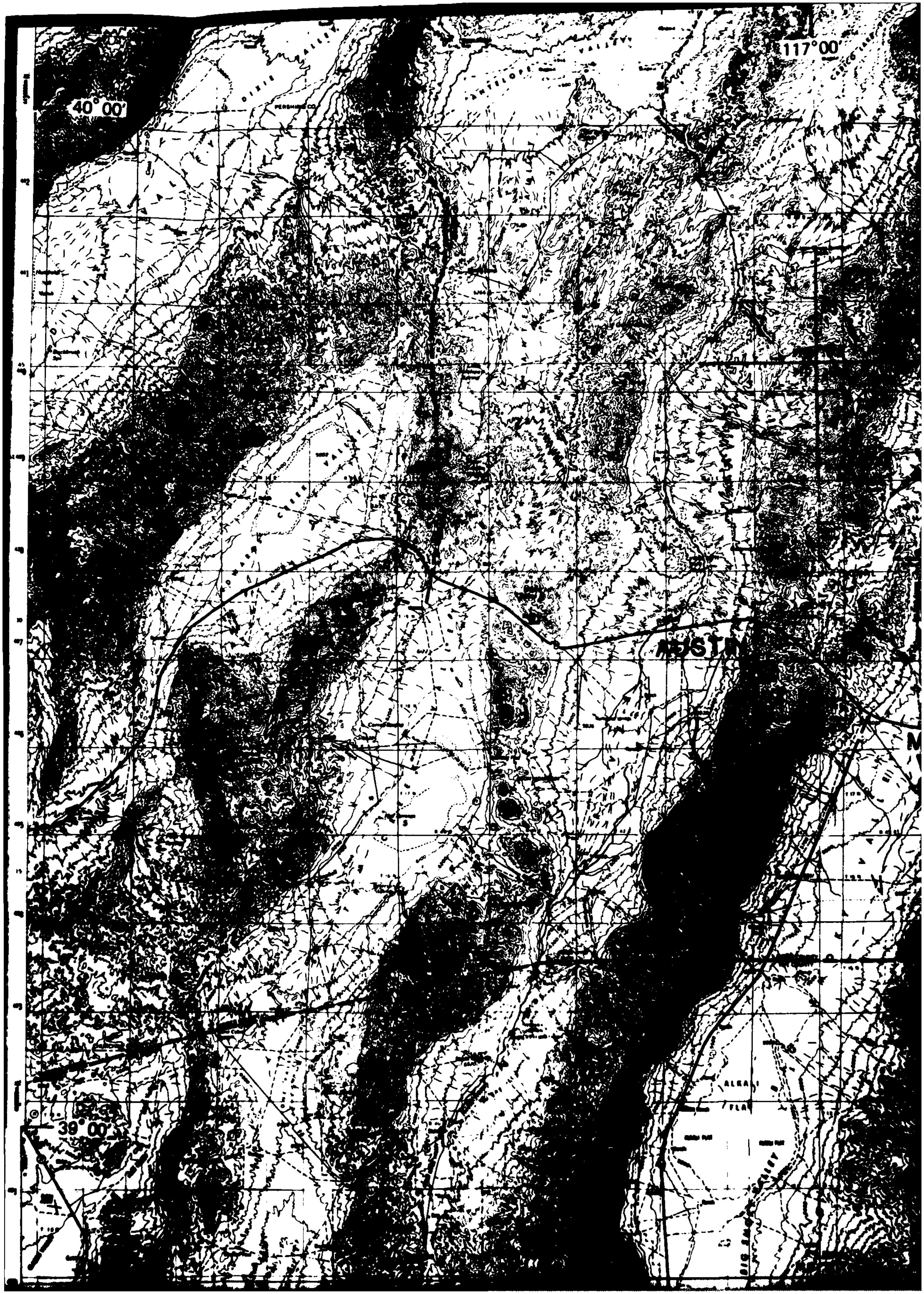
The Earth Technology Corporation

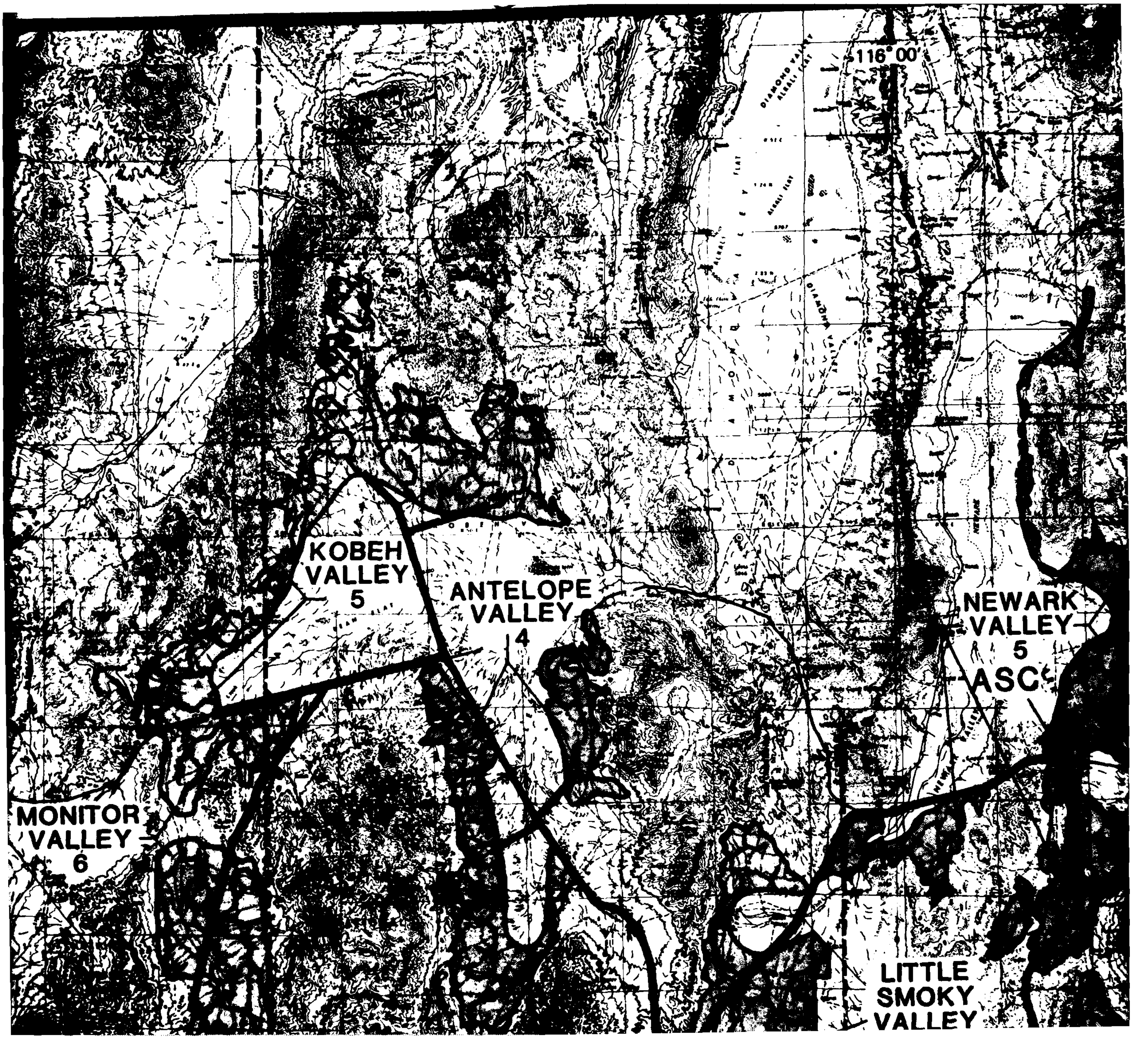
MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

MAP OF YOUNG FAULTS AND LINEAMENTS IN THE MX DEPLOYMENT AREA, EAST-CENTRAL NEVADA AND WEST-CENTRAL UTAH

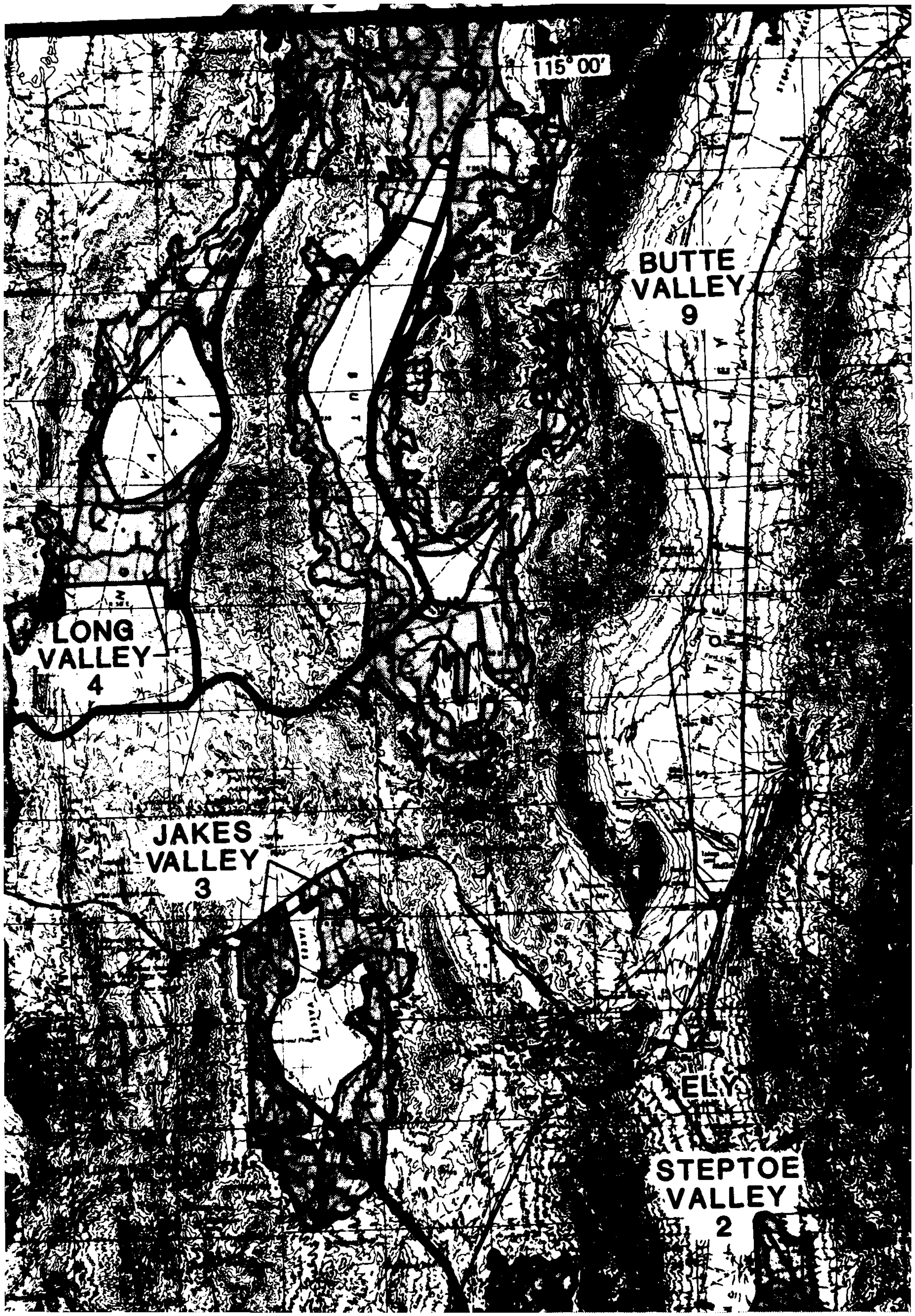
6 NOV 81

DRAWING 2-2

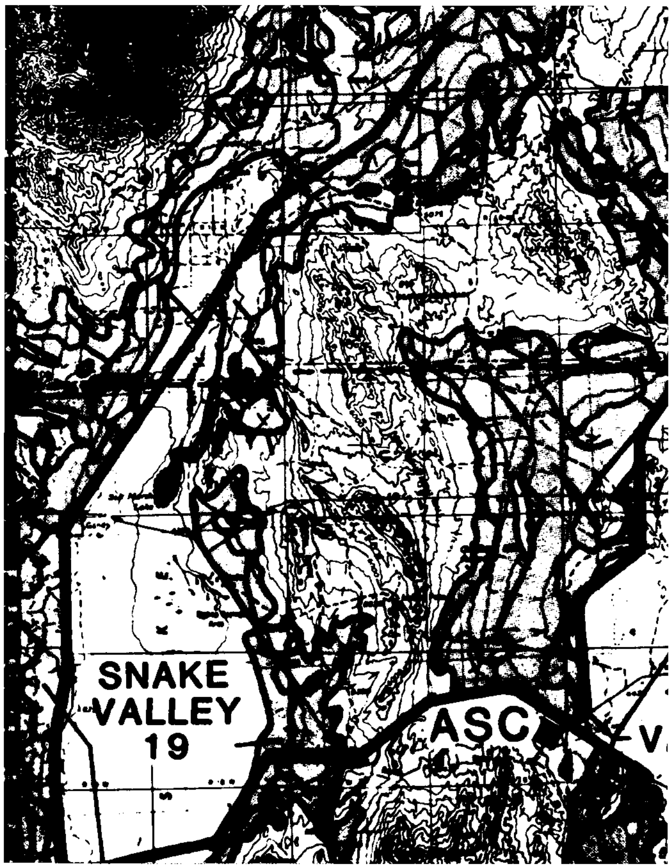

40°00'
117°00'
AUSTIN
39°00'
ALKALI
FLAT



116°00'
KOBEH
VALLEY
5
ANTELOPE
VALLEY
4
NEWARK
VALLEY
5
MONITOR
VALLEY
6
LITTLE
SMOKY
VALLEY

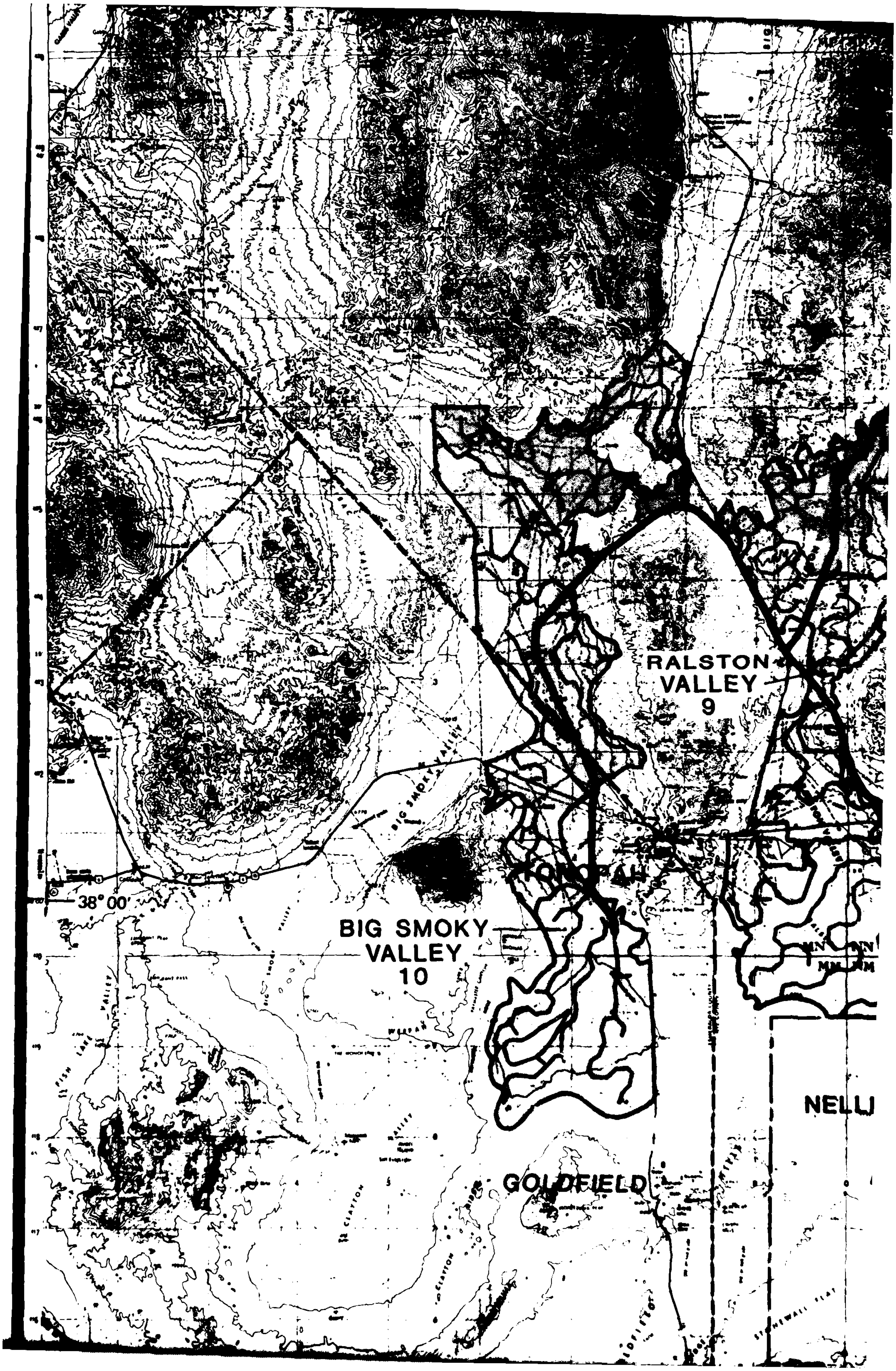


115° 00'
BUTTE
VALLEY
9
LONG
VALLEY
4
JAKES
VALLEY
3
ELY
STEPTOE
VALLEY
2



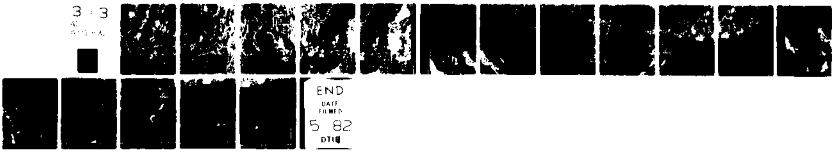
SNAKE
VALLEY
19
ASC
V


DUGWAY VALLEY 5
113° 00'
40° 00'
SEVIER DESERT 2
DELTA
WHIRLWIND VALLEY 12
SEVIER LAKE 1
39° 00'


RALSTON
VALLEY
9
38°00'
BIG SMOKY
VALLEY
10
GOLDFIELD
NELLI

AD-A112 532 ERTEC WESTERN INC LONG BEACH CA F/G 13/2
EXECUTIVE SUMMARY GEOTECHNICAL SITING INVESTIGATIONS FY 81.(U)
NOV 81 F04704-80-C-0006
UNCLASSIFIED E-TR-55 NL

3 of 3



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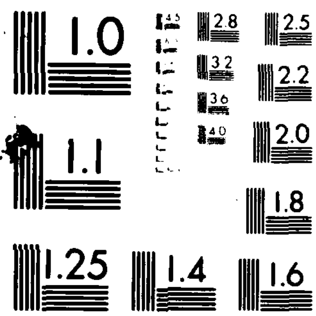
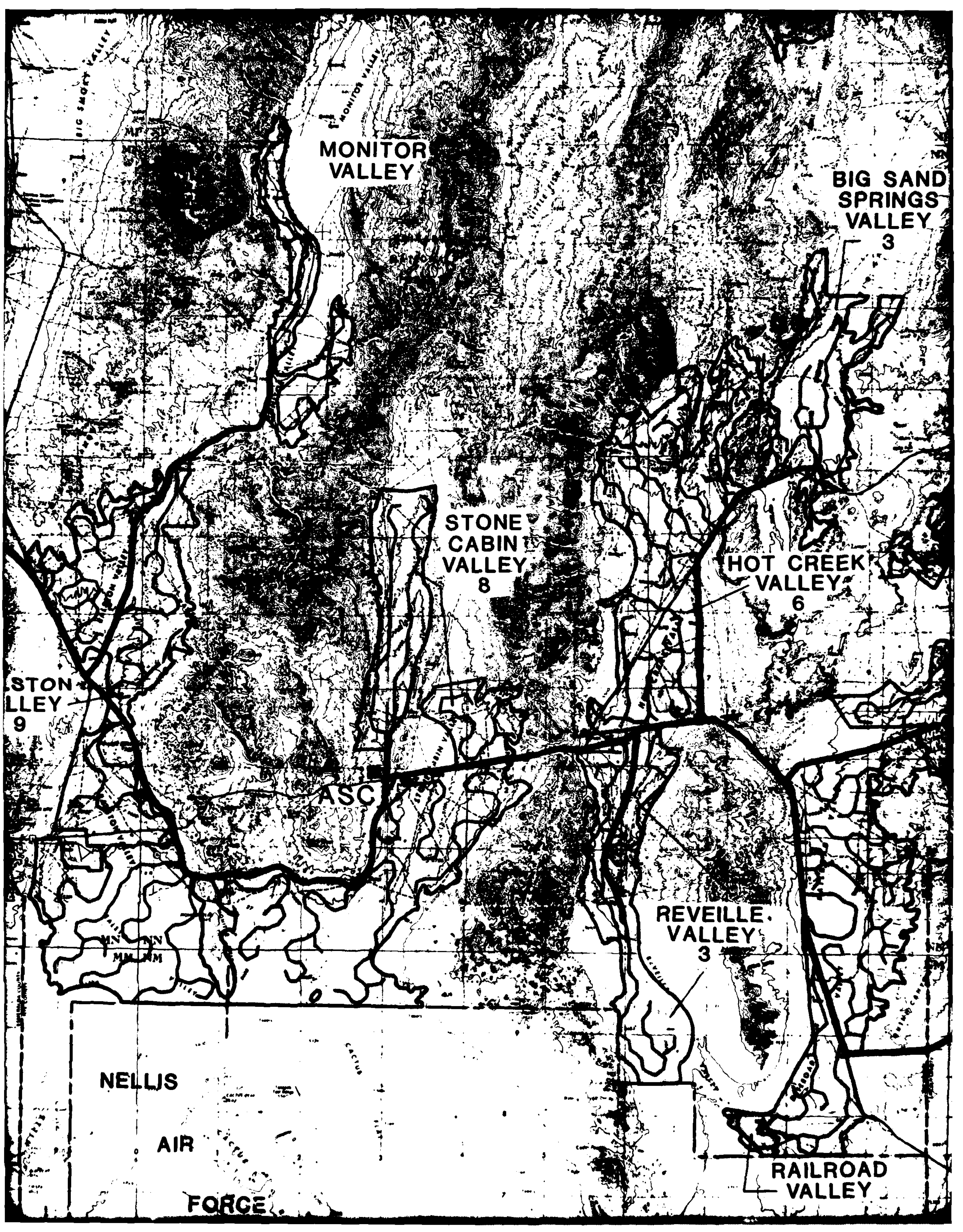
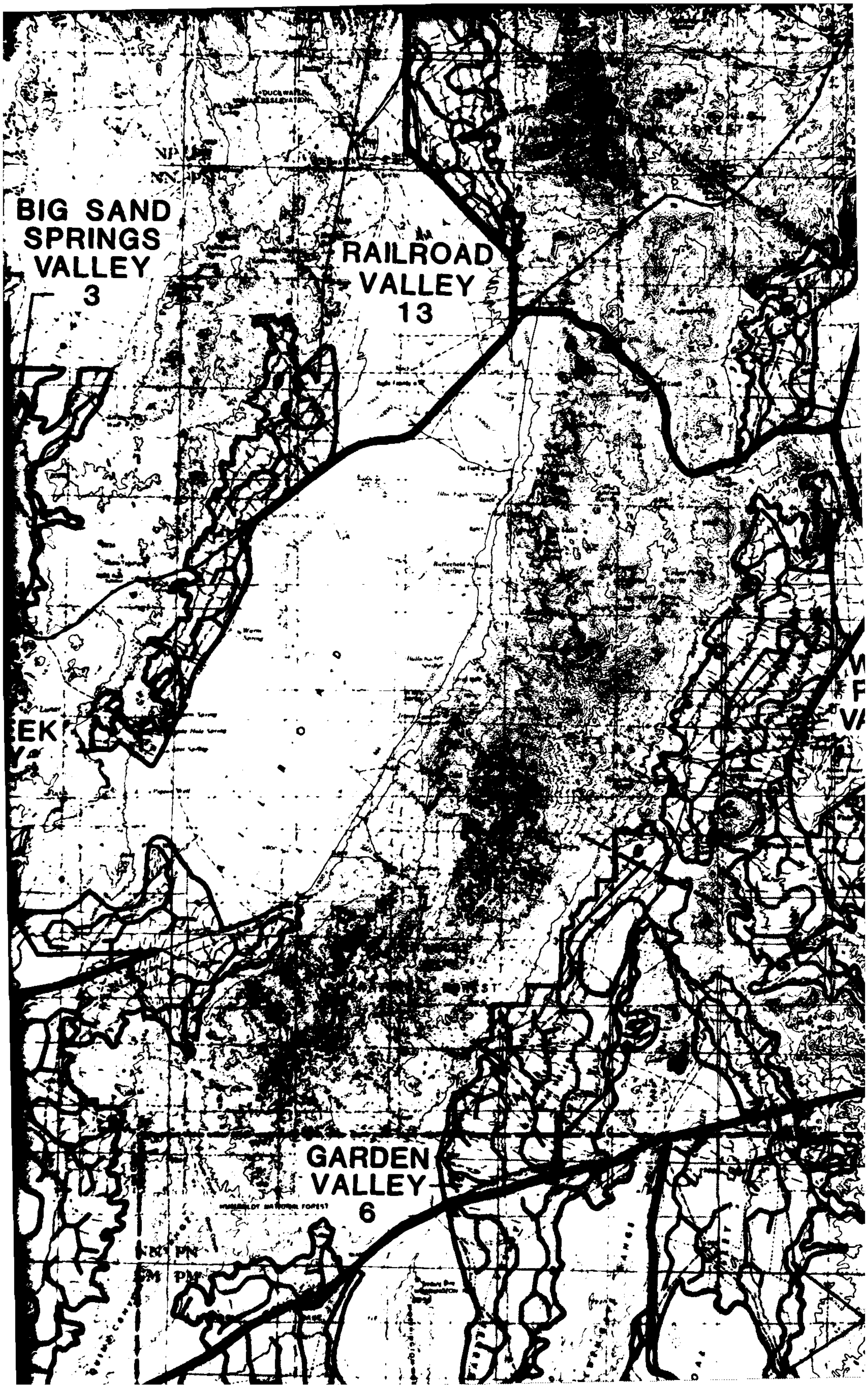
5 82
DTIC

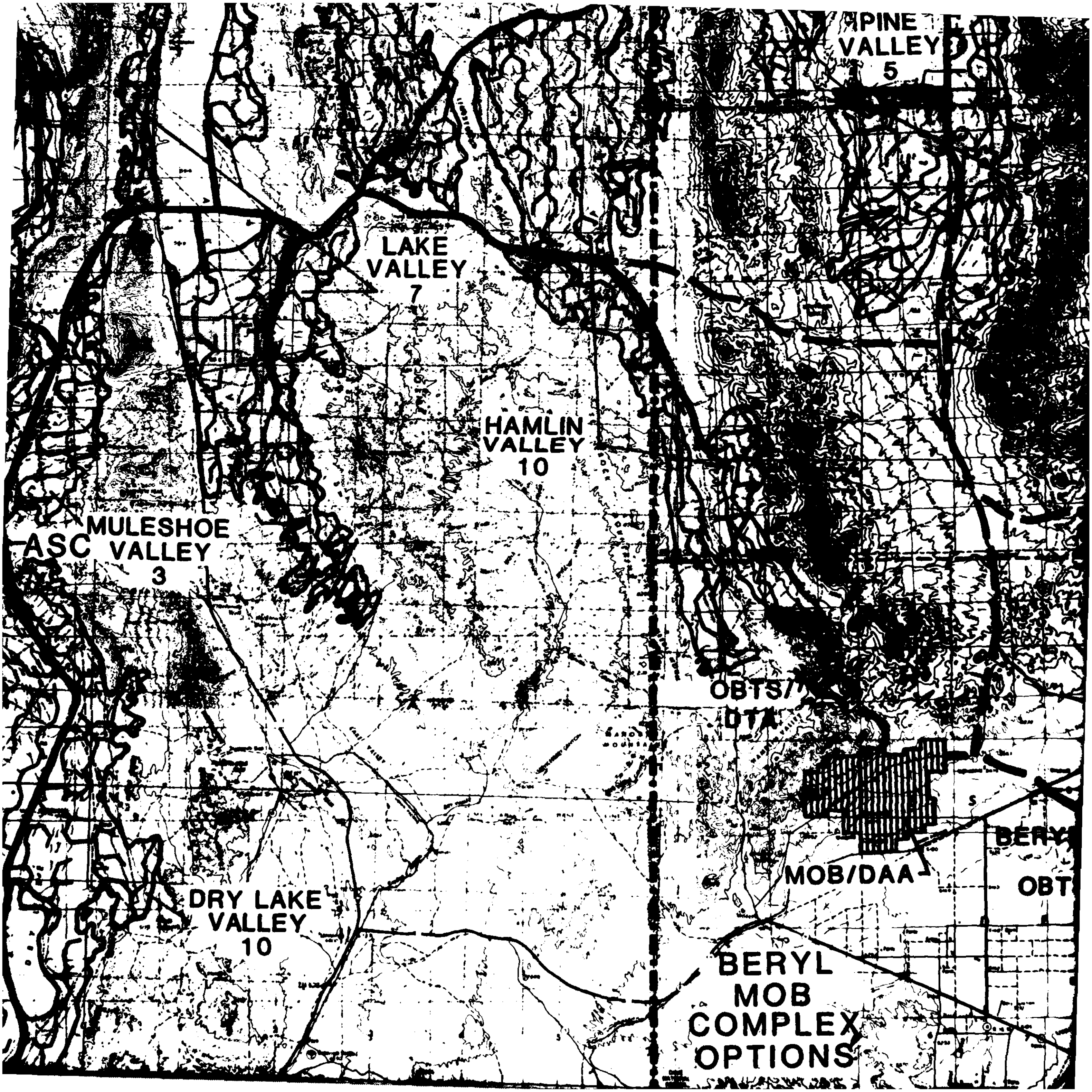


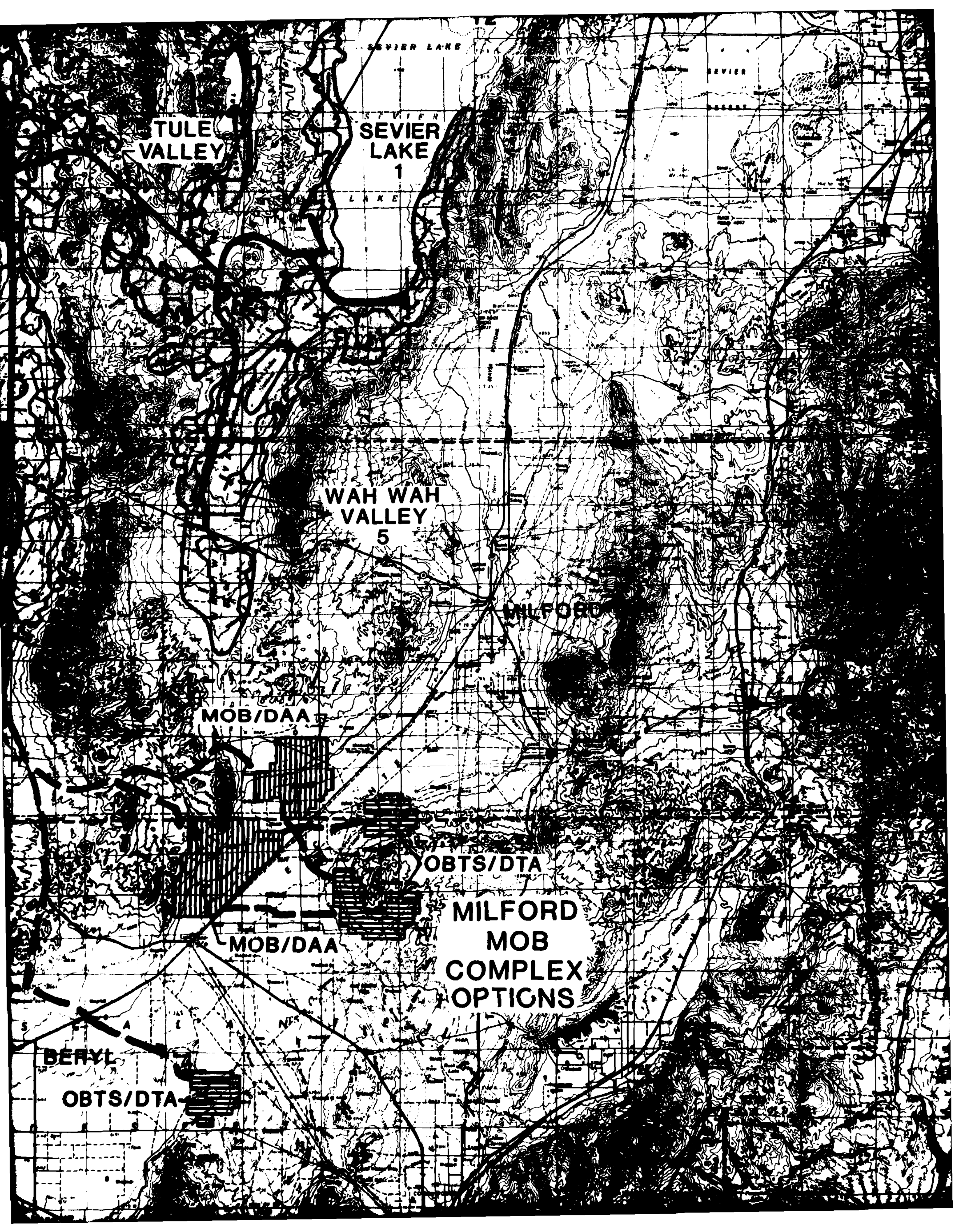
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

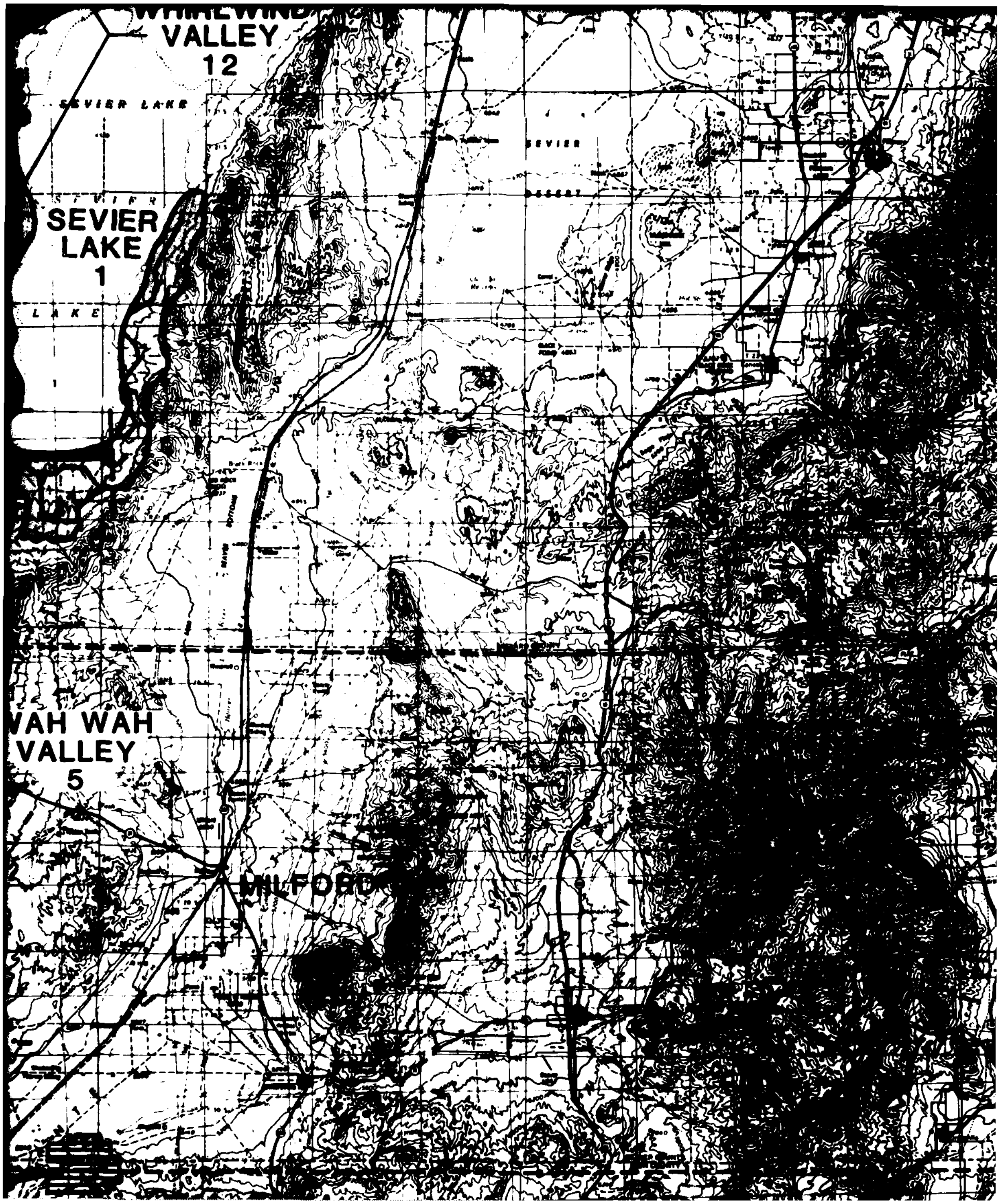


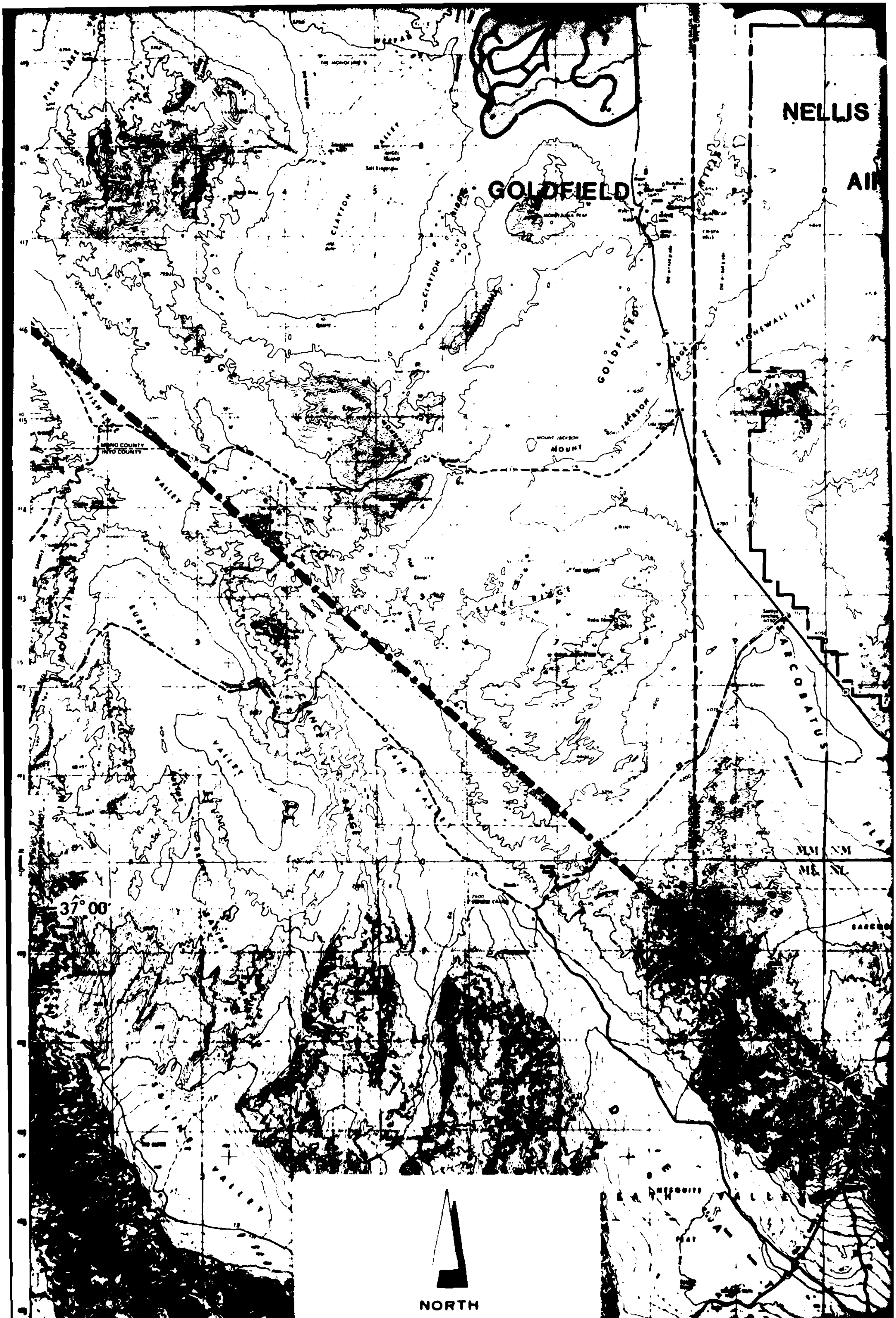
MONITOR VALLEY
BIG SAND SPRINGS VALLEY 3
STONE CABIN VALLEY 8
HOT CREEK VALLEY 6
STON LLEY 9
ASC
REVEILLE VALLEY 3
NELLIS
AIR
FORCE
RAILROAD VALLEY

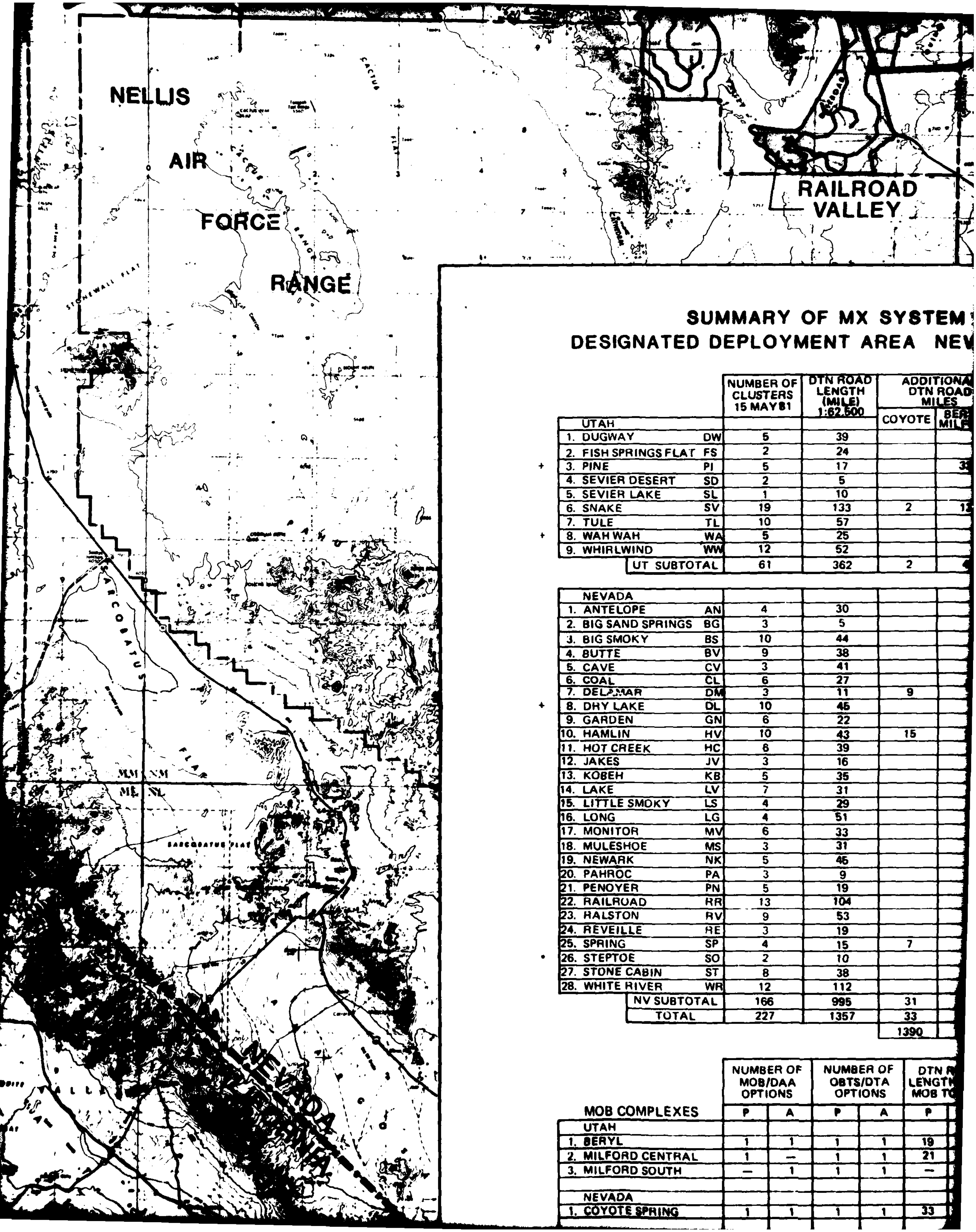

BIG SAND
SPRINGS
VALLEY
3
RAILROAD
VALLEY
13
GARDEN
VALLEY
6


PINE VALLEY 5
LAKE VALLEY 7
HAMLIN VALLEY 10
MULESHOE VALLEY 3
ASC
OBTS/ DTA
MOB/DAA
BERY
OBT
DRY LAKE VALLEY 10
BERYL MOB COMPLEX OPTIONS


SEVIER LAKE
TULE VALLEY
SEVIER LAKE 1
WAH WAH VALLEY 5
MILFORD
MOB/DAA
OBTS/DTA
MILFORD MOB COMPLEX OPTIONS
MOB/DAA
BERYL
OBTS/DTA


VALLEY
12
SEVIER LAKE
SEVIER
DESERT
SEVIER
LAKE
1
LAKE
WAH WAH
VALLEY
5
MILFORD

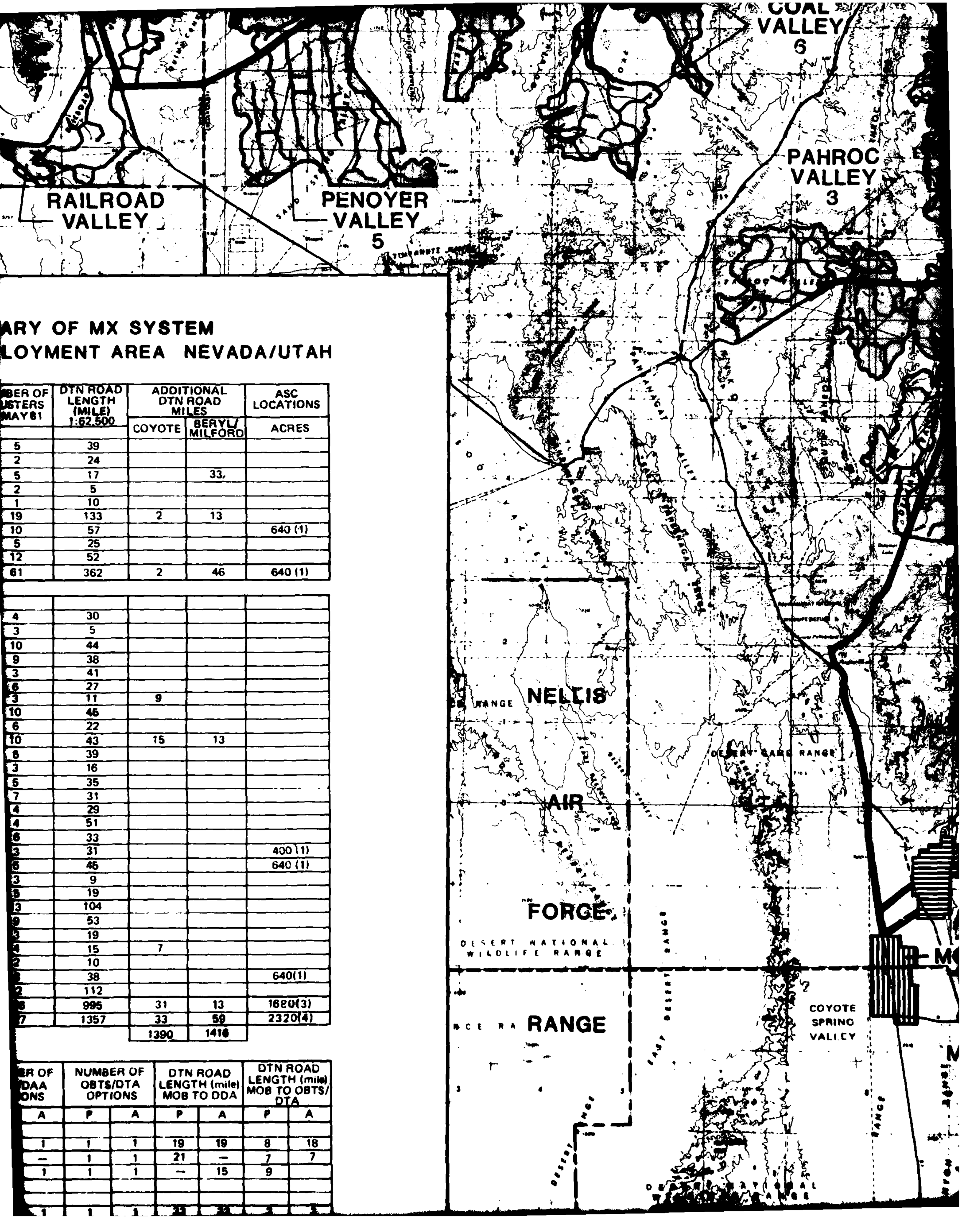

NELLIS
GOLDFIELD
STONEWALL FLAT
SLATE RIDGE
MONO COUNTY
INYO COUNTY
SARCOBATUS
MM NM
MM NL
37° 00'
NORTH



SUMMARY OF MX SYSTEM
DESIGNATED DEPLOYMENT AREA NEV

			NUMBER OF CLUSTERS 15 MAY 81	DTN ROAD LENGTH (MILE) 1:62,500	ADDITIONA DTN ROAD MILES	
					COYOTE	BER MIL
	UTAH					
	1. DUGWAY	DW	5	39		
	2. FISH SPRINGS FLAT	FS	2	24		
+	3. PINE	PI	5	17		3
	4. SEVIER DESERT	SD	2	5		
	5. SEVIER LAKE	SL	1	10		
	6. SNAKE	SV	19	133	2	1
	7. TULE	TL	10	57		
+	8. WAH WAH	WA	5	25		
	9. WHIRLWIND	WW	12	52		
	UT SUBTOTAL		61	362	2	[illegible]
	NEVADA					
	1. ANTELOPE	AN	4	30		
	2. BIG SAND SPRINGS	BG	3	5		
	3. BIG SMOKY	BS	10	44		
	4. BUTTE	BV	9	38		
	5. CAVE	CV	3	41		
	6. COAL	CL	6	27		
	7. DELAMAR	DM	3	11	9	
+	8. DRY LAKE	DL	10	46		
	9. GARDEN	GN	6	22		
	10. HAMLIN	HV	10	43	15	
	11. HOT CREEK	HC	8	39		
	12. JAKES	JV	3	16		
	13. KOBEH	KB	5	35		
	14. LAKE	LV	7	31		
	15. LITTLE SMOKY	LS	4	29		
	16. LONG	LG	4	51		
	17. MONITOR	MV	6	33		
	18. MULESHOE	MS	3	31		
	19. NEWARK	NK	5	45		
	20. PAHROC	PA	3	9		
	21. PENOYER	PN	5	19		
	22. RAILROAD	RR	13	104		
	23. RALSTON	RV	9	53		
	24. REVEILLE	RE	3	19		
	25. SPRING	SP	4	15	7	
•	26. STEPTOE	SO	2	10		
	27. STONE CABIN	ST	8	38		
	28. WHITE RIVER	WR	12	112		
	NV SUBTOTAL		166	995	31	
	TOTAL		227	1357	33	
					1390	

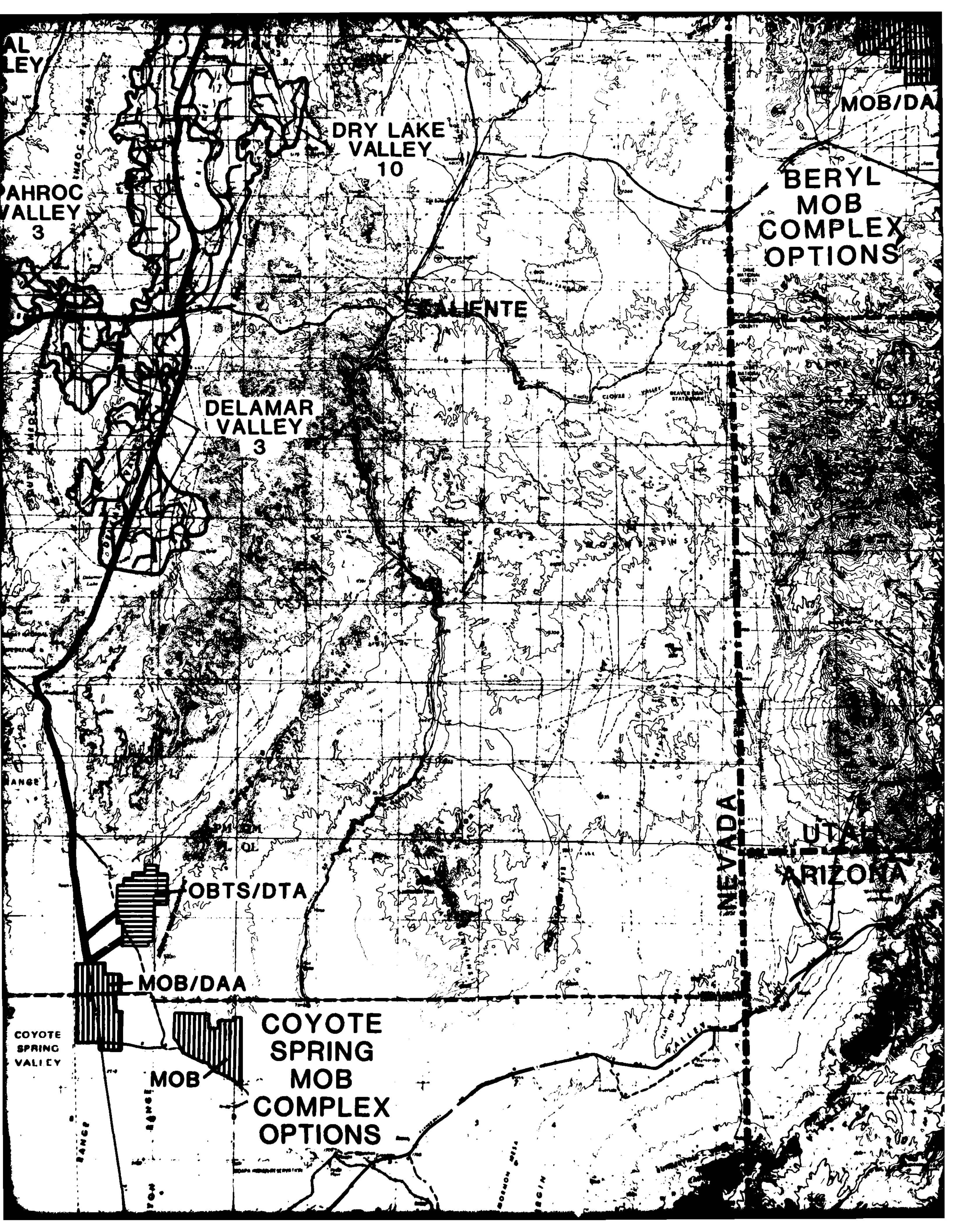
MOB COMPLEXES	NUMBER OF MOB/DAA OPTIONS		NUMBER OF OBTS/DTA OPTIONS		DTN R LENGTH MOB TO
	P	A	P	A	P
UTAH					
1. BERYL	1	1	1	1	19
2. MILFORD CENTRAL	1	—	1	1	21
3. MILFORD SOUTH	—	1	1	1	—
NEVADA					
1. COYOTE SPRING	1	1	1	1	33



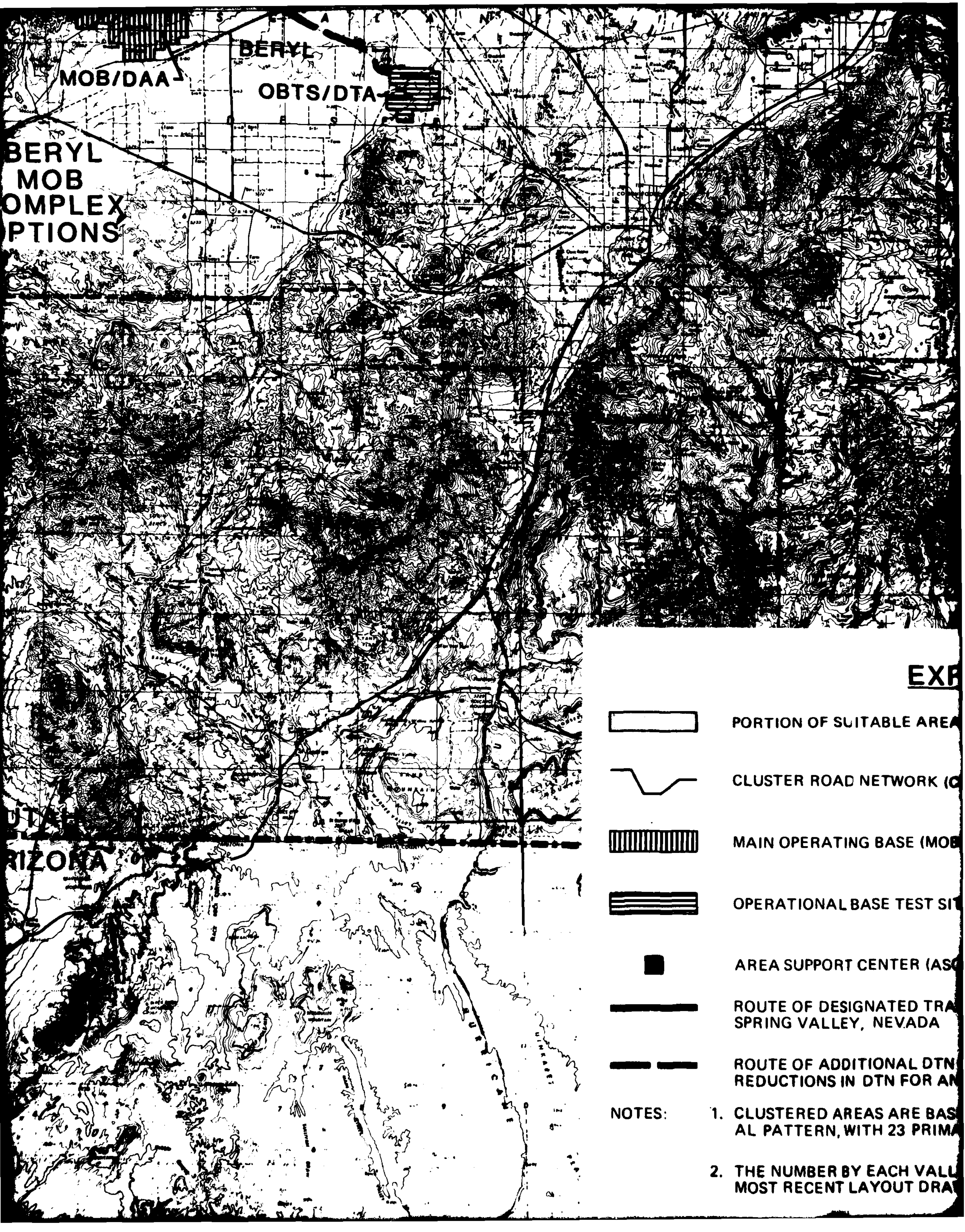
ARY OF MX SYSTEM LOYMENT AREA NEVADA/UTAH

BER OF USTERS MAY81	DTN ROAD LENGTH (MILE) 1:62,500	ADDITIONAL DTN ROAD MILES		ASC LOCATIONS
		COYOTE	BERYL/ MILFORD	ACRES
5	39			
2	24			
5	17		33,	
2	5			
1	10			
19	133	2	13	
10	57			640 (1)
5	25			
12	52			
61	362	2	46	640 (1)
4	30			
3	5			
10	44			
9	38			
3	41			
6	27			
3	11	9		
10	46			
6	22			
10	43	15	13	
6	39			
3	16			
5	35			
7	31			
4	29			
4	51			
6	33			
3	31			400 (1)
6	45			640 (1)
3	9			
6	19			
3	104			
9	53			
3	19			
4	15	7		
2	10			
3	38			640(1)
2	112			
8	995	31	13	1680(3)
7	1357	33	59	2320(4)
		1390	1416	

ER OF DAA ONS	NUMBER OF OBTS/DTA OPTIONS		DTN ROAD LENGTH (mile) MOB TO DDA		DTN ROAD LENGTH (mile) MOB TO OBTS/ DTA	
A	P	A	P	A	P	A
1	1	1	19	19	8	18
—	1	1	21	—	7	7
1	1	1	—	15	9	
1	1	1	[illegible]	[illegible]	[illegible]	[illegible]



AL
LEY
DRY LAKE
VALLEY
10
PAHROC
VALLEY
3
MOB/DA
BERYL
MOB
COMPLEX
OPTIONS
CALIENTE
DELAMAR
VALLEY
3
RANGE
NEVADA
UTAH
ARIZONA
OBTS/DTA
MOB/DAA
COYOTE
SPRING
VALLEY
COYOTE
SPRING
MOB
COMPLEX
OPTIONS
MOB



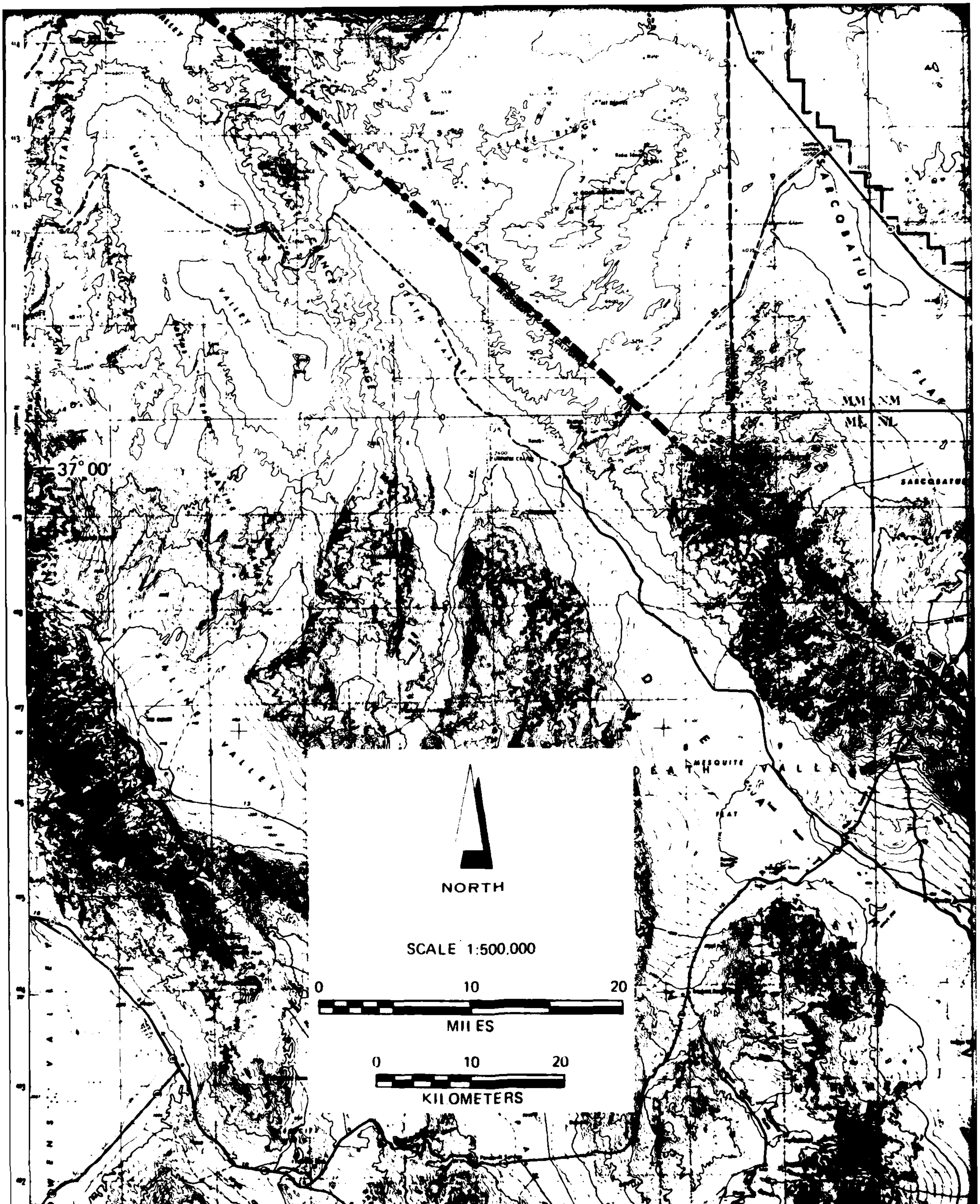
BERYL
MOB/DAA
OBTS/DTA
BERYL
MOB
OMPLEX
PTIONS
UTAH
RIZONA
EXP
PORTION OF SUITABLE AREA
CLUSTER ROAD NETWORK (C
MAIN OPERATING BASE (MOB
OPERATIONAL BASE TEST SIT
AREA SUPPORT CENTER (AS
ROUTE OF DESIGNATED TRA
SPRING VALLEY, NEVADA
ROUTE OF ADDITIONAL DTN
REDUCTIONS IN DTN FOR AN
NOTES:
1. CLUSTERED AREAS ARE BAS
AL PATTERN, WITH 23 PRIMA
2. THE NUMBER BY EACH VALU
MOST RECENT LAYOUT DRA

EXPLANATION

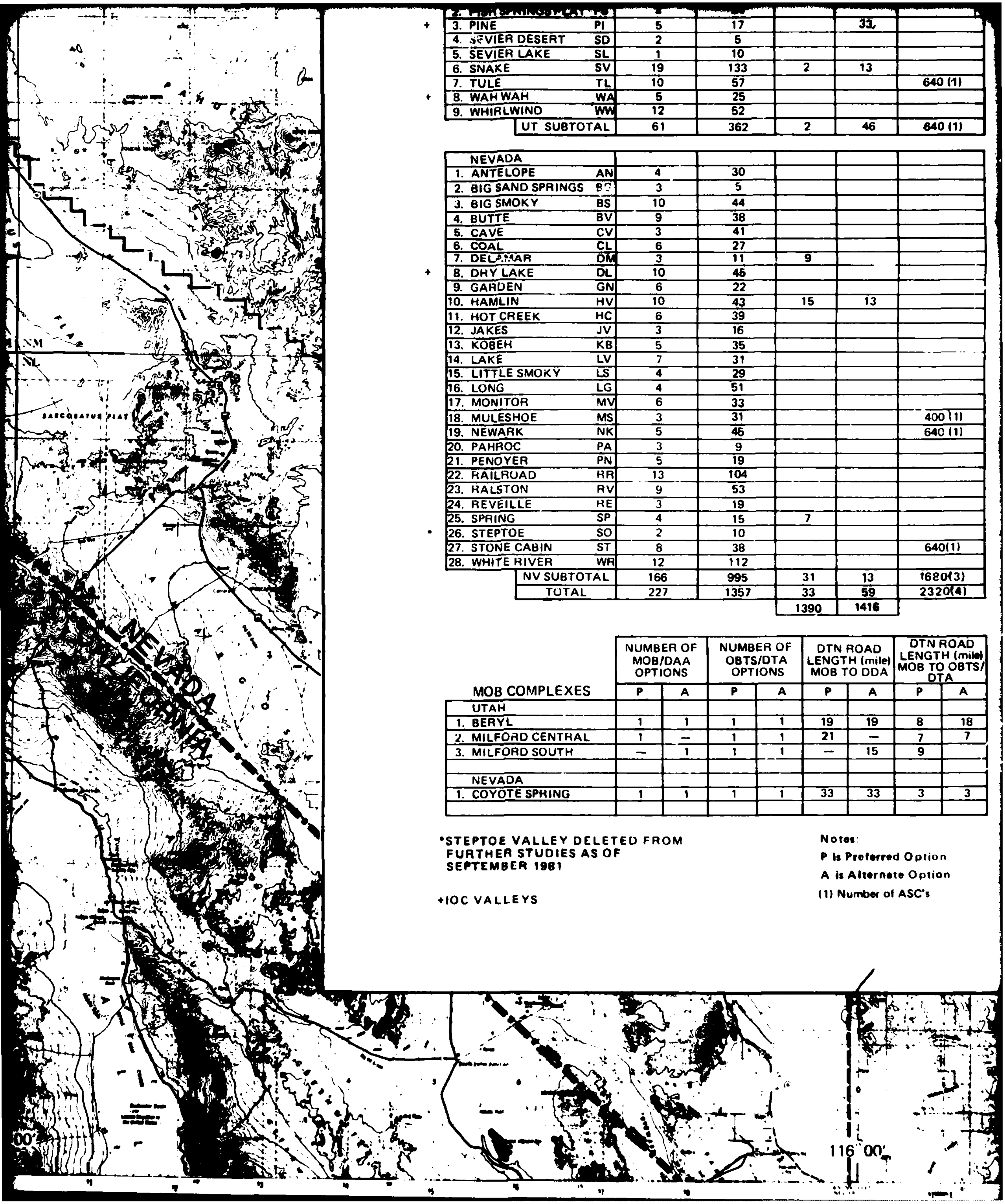
- PORTION OF SUITABLE AREA CLUSTERED
- CLUSTER ROAD NETWORK (CRN)
- MAIN OPERATING BASE (MOB)/DESIGNATED ASSEMBLY AREA (DAA) OPTIONS
- OPERATIONAL BASE TEST SITE (OBTS)/DESIGNATED TRAINING AREA (DTA) OPTIONS
- AREA SUPPORT CENTER (ASC)
- ROUTE OF DESIGNATED TRANSPORTATION NETWORK (DTN) FOR MOB SITE IN COYOTE SPRING VALLEY, NEVADA
- ROUTE OF ADDITIONAL DTN FOR MOB SITE AT BERYL OR MILFORD, UTAH. REDUCTIONS IN DTN FOR AN MOB SITE IN COYOTE SPRING VALLEY ARE NOT SHOWN.

NOTES:

1. CLUSTERED AREAS ARE BASED ON 5200 ± 200– FOOT SPACING, 2/3 FILLED HEXAGONAL PATTERN, WITH 23 PRIMARY MULTIPLE PROTECTIVE STRUCTURES (SHELTERS).
2. THE NUMBER BY EACH VALLEY NAME IS THE NUMBER OF CLUSTERS BASED ON THE MOST RECENT LAYOUT DRAWINGS.
3. MOB/DAA AND OBTS/DTA OPTIONS REPRESENT LAND PARCEL DESCRIPTIONS DEPICTED IN LAND ACQUISITION PACKAGE (17 SEPT 81).



SARCOBATUS
FLAT
MM NM
ML NL
37° 00'
SARCOBATUS
DEATH VALLEY
MESQUITE
FLAT
NORTH
SCALE 1:500,000
0 10 20
MILES
0 10 20
KILOMETERS
117° 00'



2. FISH SPRINGS FLAT	FS	[illegible]	[illegible]			
+ 3. PINE	PI	5	17		33	
4. SEVIER DESERT	SD	2	5			
5. SEVIER LAKE	SL	1	10			
6. SNAKE	SV	19	133	2	13	
7. TULE	TL	10	57			640 (1)
+ 8. WAH WAH	WA	5	25			
9. WHIRLWIND	WW	12	52			
UT SUBTOTAL		61	362	2	46	640 (1)

NEVADA						
1. ANTELOPE	AN	4	30			
2. BIG SAND SPRINGS	BS	3	5			
3. BIG SMOKY	BS	10	44			
4. BUTTE	BV	9	38			
5. CAVE	CV	3	41			
6. COAL	CL	6	27			
7. DELAMAR	DM	3	11	9		
+ 8. DRY LAKE	DL	10	46			
9. GARDEN	GN	6	22			
10. HAMLIN	HV	10	43	15	13	
11. HOT CREEK	HC	6	39			
12. JAKES	JV	3	16			
13. KOBEH	KB	5	35			
14. LAKE	LV	7	31			
15. LITTLE SMOKY	LS	4	29			
16. LONG	LG	4	51			
17. MONITOR	MV	6	33			
18. MULESHOE	MS	3	31			400 (1)
19. NEWARK	NK	5	46			640 (1)
20. PAHROC	PA	3	9			
21. PENOYER	PN	5	19			
22. RAILROAD	RR	13	104			
23. RALSTON	RV	9	53			
24. REVEILLE	RE	3	19			
25. SPRING	SP	4	15	7		
* 26. STEPTOE	SO	2	10			
27. STONE CABIN	ST	8	38			640(1)
28. WHITE RIVER	WR	12	112			
NV SUBTOTAL		166	995	31	13	1680(3)
TOTAL		227	1357	33	59	2320(4)
				1390	1416	

MOB COMPLEXES	NUMBER OF MOB/DAA OPTIONS		NUMBER OF OBTS/DTA OPTIONS		DTN ROAD LENGTH (mile) MOB TO DDA		DTN ROAD LENGTH (mile) MOB TO OBTS/DTA	
	P	A	P	A	P	A	P	A
UTAH								
1. BERYL	1	1	1	1	19	19	8	18
2. MILFORD CENTRAL	1	—	1	1	21	—	7	7
3. MILFORD SOUTH	—	1	1	1	—	15	9	
NEVADA								
1. COYOTE SPRING	1	1	1	1	33	33	3	3

*STEPTOE VALLEY DELETED FROM FURTHER STUDIES AS OF SEPTEMBER 1981

+IOC VALLEYS

Notes:

P is Preferred Option

A is Alternate Option

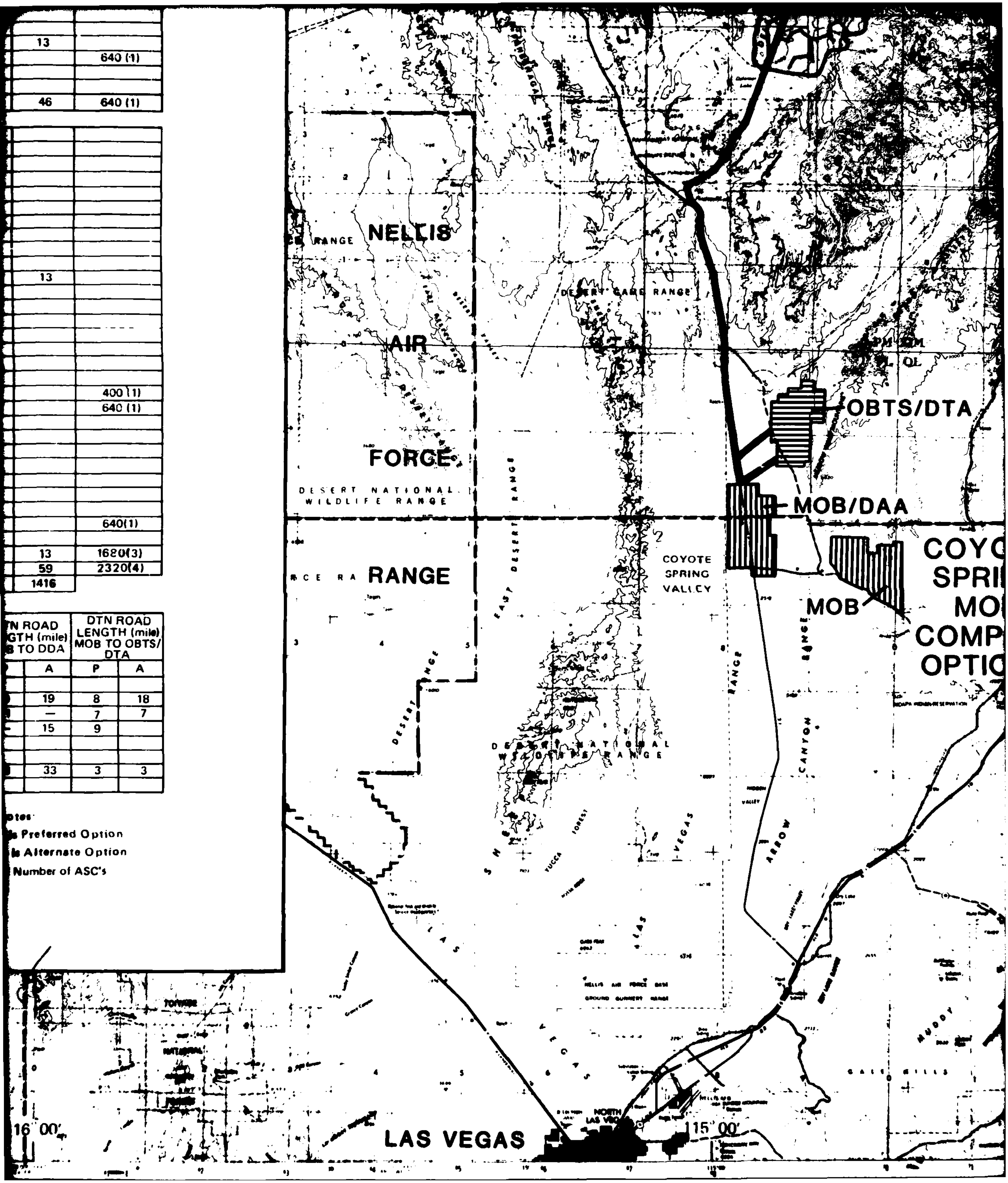
(1) Number of ASC's

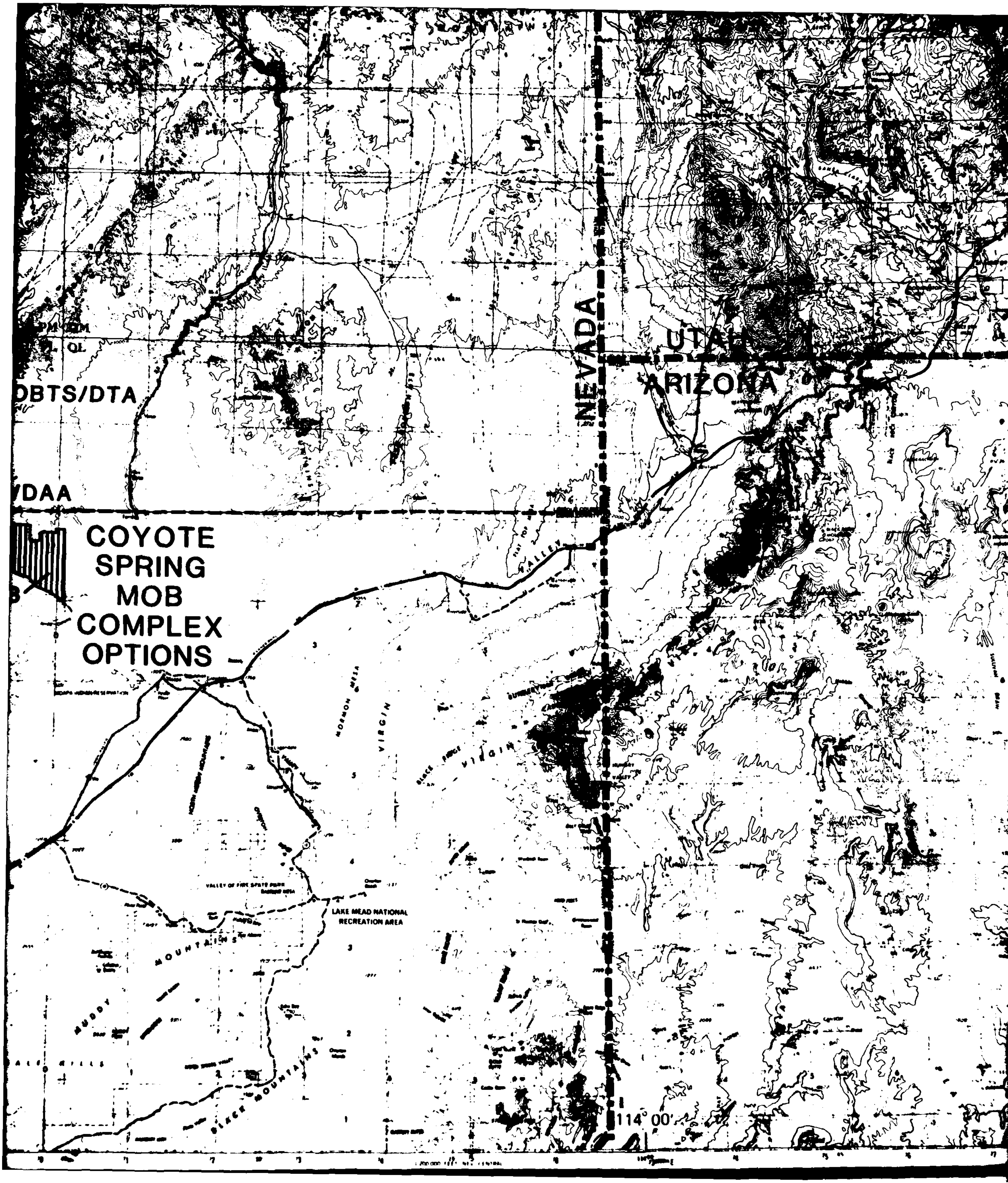
13	
	640 (1)
46	640 (1)

13	
	- - -
	400 (1)
	640 (1)
	640(1)
13	1680(3)
59	2320(4)
1416	

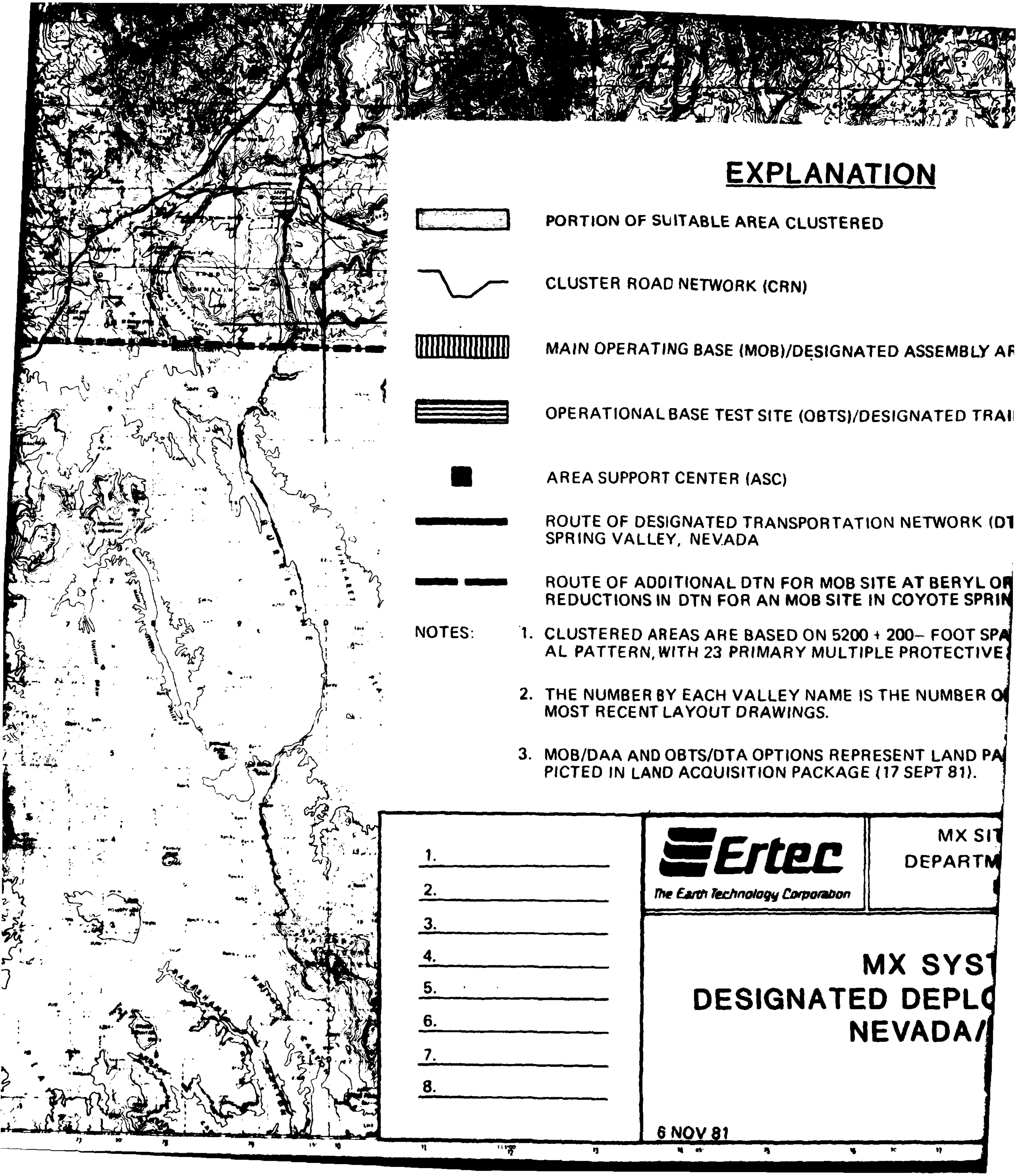
…N ROAD …GTH (mile) …B TO DDA		DTN ROAD LENGTH (mile) MOB TO OBTS/DTA	
	A	P	A
	19	8	18
	—	7	7
	15	9	
	33	3	3

…otes:
…s Preferred Option
…s Alternate Option
… Number of ASC's





NEVADA
UTAH
ARIZONA
DBTS/DTA
DAA
COYOTE
SPRING
MOB
COMPLEX
OPTIONS
MORMON MESA
VIRGIN
MUDDY MOUNTAINS
BLACK MOUNTAINS
VALLEY OF FIRE STATE PARK
LAKE MEAD NATIONAL
RECREATION AREA
114° 00'



EXPLANATION

PORTION OF SUITABLE AREA CLUSTERED

CLUSTER ROAD NETWORK (CRN)

MAIN OPERATING BASE (MOB)/DESIGNATED ASSEMBLY AR

OPERATIONAL BASE TEST SITE (OBTS)/DESIGNATED TRAI

AREA SUPPORT CENTER (ASC)

ROUTE OF DESIGNATED TRANSPORTATION NETWORK (DT
SPRING VALLEY, NEVADA

ROUTE OF ADDITIONAL DTN FOR MOB SITE AT BERYL OR
REDUCTIONS IN DTN FOR AN MOB SITE IN COYOTE SPRIN

NOTES:

1. CLUSTERED AREAS ARE BASED ON 5200 + 200– FOOT SPA
AL PATTERN, WITH 23 PRIMARY MULTIPLE PROTECTIVE
2. THE NUMBER BY EACH VALLEY NAME IS THE NUMBER O
MOST RECENT LAYOUT DRAWINGS.
3. MOB/DAA AND OBTS/DTA OPTIONS REPRESENT LAND PA
PICTED IN LAND ACQUISITION PACKAGE (17 SEPT 81).

1. ____
2. ____
3. ____
4. ____
5. ____
6. ____
7. ____
8. ____

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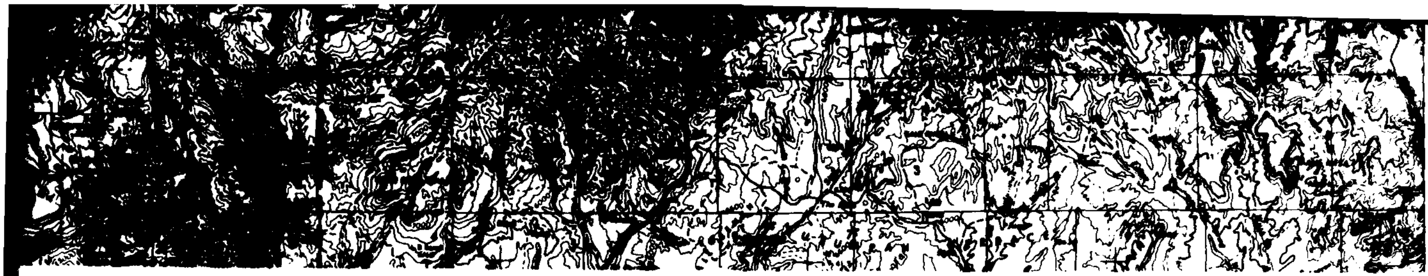
MX SI
DEPARTM

MX SYS
DESIGNATED DEPL
NEVADA/

6 NOV 81



EXPLANATION

PORTION OF SUITABLE AREA CLUSTERED

CLUSTER ROAD NETWORK (CRN)

MAIN OPERATING BASE (MOB)/DESIGNATED ASSEMBLY AREA (DAA) OPTIONS

OPERATIONAL BASE TEST SITE (OBTS)/DESIGNATED TRAINING AREA (DTA) OPTIONS

AREA SUPPORT CENTER (ASC)

ROUTE OF DESIGNATED TRANSPORTATION NETWORK (DTN) FOR MOB SITE IN COYOTE SPRING VALLEY, NEVADA

ROUTE OF ADDITIONAL DTN FOR MOB SITE AT BERYL OR MILFORD, UTAH. REDUCTIONS IN DTN FOR AN MOB SITE IN COYOTE SPRING VALLEY ARE NOT SHOWN.

NOTES:

1. CLUSTERED AREAS ARE BASED ON 5200 + 200– FOOT SPACING, 2/3 FILLED HEXAGONAL PATTERN, WITH 23 PRIMARY MULTIPLE PROTECTIVE STRUCTURES (SHELTERS).
2. THE NUMBER BY EACH VALLEY NAME IS THE NUMBER OF CLUSTERS BASED ON THE MOST RECENT LAYOUT DRAWINGS.
3. MOB/DAA AND OBTS/DTA OPTIONS REPRESENT LAND PARCEL DESCRIPTIONS DEPICTED IN LAND ACQUISITION PACKAGE (17 SEPT 81).

1. ______
2. ______
3. ______
4. ______
5. ______
6. ______
7. ______
8. ______

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MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

MX SYSTEM
DESIGNATED DEPLOYMENT AREA
NEVADA/UTAH

6 NOV 81 DRAWING 5-1

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